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ABSTRACT

This guide provides the basic foundation to develop a one-semester course based on the cluster concept, manufacturing technology. One of a set of six guides for an industrial arts curriculum at the junior high school level, it suggests activities that allow students (1) to become familiar with and use some of the tools, materials, and processes needed in the manufacturing phase of industry, and (2) to become aware of occupations in the manufacturing field. Following an introduction covering rationale, cluster outline and objectives, and cluster taxonomic structure, fourteen units are presented: structure of industry, elements of manufacturing, mass production and automation, primary metals industry, casting metal, forging and forming metal, measuring and layout (English and/or metric), machining and finishing metal, fastening and finishing metal, lumbering and forest products, cutting and shaping wood, assembling and finishing wood, plastic material and processes, and opportunities in manufacturing. Each unit includes unit objectives, student competencies and related student activities, illustrations and diagrams, and where applicable, directions for student projects. A bibliography of films and other materials, and a listing of equipment are appended. (SH)

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ED147462

INDUSTRIAL ARTS

MANUFACTURING TECHNOLOGY

Curriculum Guide

U.S. DEPARTMENT OF HEALTH
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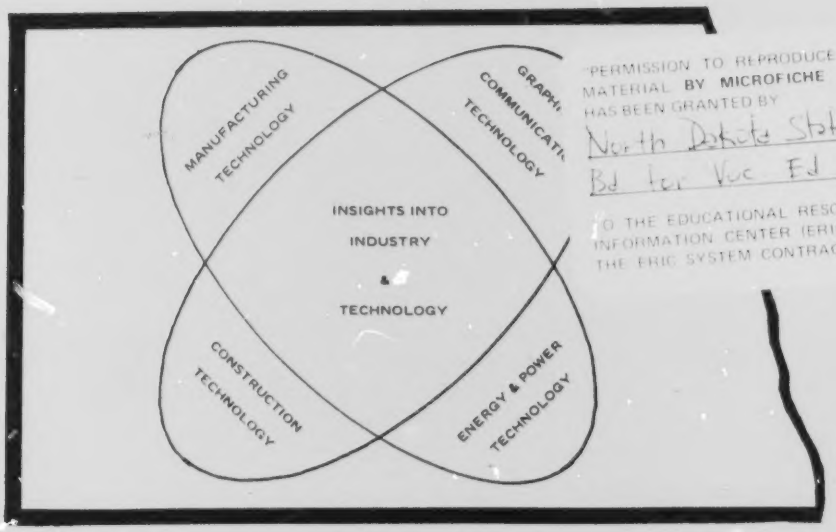

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Bismarck, North Dakota

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MANUFACTURING TECHNOLOGY

RATIONALE: The concept of manufacturing is defined to include all those activities related to the production of goods and services to meet the wants and needs of man. It is a concept that has been in existence as long as man himself. Even though manufacturing or securing of goods for survival of early man may have been quite simple in modern context, the concept did exist. In this context the concept of manufacturing is fundamental to the existence of man and supported by other related areas.

The concept of manufacturing has three main elements; 1. input which includes an enterprise system, resources and personnel; 2. material processes which includes processing raw material, combining, and finishing; and 3. the output for a needed and desirable product. These elements seemed basic to manufacturing industries with better exception to their complexity.

OBJECTIVES: The objectives of Manufacturing Technology instruction is the study of information and occupations utilizing a variety of materials. It will provide an opportunity for each student to become familiar with the industrial society. The study of the manufacturing industry will help each student understand the nature of work in manufacturing industries. It will include the managed use of tools, materials, and processes needed in the manufacturing phase of industries.

Primary objectives of Manufacturing Technology are to assist the student:

1. To place Manufacturing Technology in the broader context of industrial technology and all of technology.
2. To be aware of the history, present character, and future of the manufacturing phase of industry.
3. To appreciate, understand, and perform selected management practices in planning, organizing, and controlling as they relate to manufacturing production systems.
4. To appreciate, understand, and perform selected personnel practices of hiring, training, working, advancing, and retiring as they relate to a managed production system in manufacturing.
5. To appreciate, understand, and perform selected production practices in pre-processing, processing, and post-processing or servicing as they apply to manufacturing production systems.
6. To appreciate and understand the interrelationships within and between management, personnel, and production practices.
7. To appreciate and have some understanding of characteristics, quality, and use of manufactured products and the tools and materials utilized in their manufacture.
8. To utilize, the knowledge and skills of manufacturing management and production to investigate factors involved in the manufacture of representative products.
9. To develop an awareness of vocations in manufacturing industries.

10. To develop responsible and safe work attitudes and the ability to function as a member of a group.
11. To develop an awareness of self-realization and generate self-activating behaviors.

INPUT

1. Level 1 Concept I

   The learner will be able to identify three elements of manufacturing input.
2. The learner will be able to identify the function of market, resources, product development, for Manufacturing Technology.

PROCESSES

1. Level 1 Concept II

   The learner will be able to identify three elements of manufacturing processes.
2. The learner will be able to identify the function of pre-processing, processing and post-processing for Manufacturing Technology.

OUTPUT

1. Level 1 Concept III

   The learner will be able to identify two elements of manufacturing output.
2. The learner will be able to identify the function of and limitations of manufactured products.

MANUFACTURING TECHNOLOGY

GUIDELINES FOR IMPLEMENTATION

The committee has arrived at the following curriculum structure for the cluster area of manufacturing. It was the goal of the committee to arrive at a structure that would:

1. serve as a transitional state to the new state curriculum guide, and
2. retain quality aspects of those existing industrial arts programs.

The committee felt the following program was structured sufficiently for teacher guidance as well as provide internal flexibility for individual teachers and local consideration.

The curriculum guide contains a conceptual framework as well as units and subordinate units, goals, objectives, and general sample activities. Each of the major units included are followed by supporting materials. The recommended days for each unit were based on 50 minute periods; and the total time spent, regardless of class period length, may also vary in actual teaching situations depending on individual teacher emphasis.

In addition to the preceeding procedures, the following recommendations were identified by the committee to be considered before implementation:

1. Each teacher should develop specified daily lesson plans from each of the units and specify activities and points for discussion.

2. Each teacher should examine the recommended days for each unit and divide the time for each of the subordinate units.
3. Each teacher should continually reinforce the concept of manufacturing by refering to individual student "projects" as prototypes.
4. Each teacher should devise their own evaluation methods for measuring student progress.
5. Each teacher should consider the sequential order of the units as suggested and may be changed to meet individual school needs.
6. Each teacher should have as a resource an Industrial Arts Curriculum Project software set for the World of Manufacturing.
7. Each teacher should have the IACP World of Manufacturing transparency set and additional sources such as:
    1. Educator's guide to free filmstrips;
    2. Educator's guide to free films;
    3. Educator's guide to free tapes and scripts;
    4. North Dakota Film Library.
8. Each teacher should consider other materials in addition to the woods, metals, and plastics developed in this curriculum.
9. Each teacher should consult the IACP World of Manufacturing price list and worksheet for tools, equipment, and supplies.
10. Each teacher should consider the recommended text. However, if a teacher has an acceptable text already purchased for student use, it would be acceptable to use a similar text. It is recommended that one copy be purchased for teacher reference.

MANUFACTURING TECHNOLOGY

CURRICULUM STRUCTURE

1.00 ELEMENTS OF MANUFACTURING INPUT

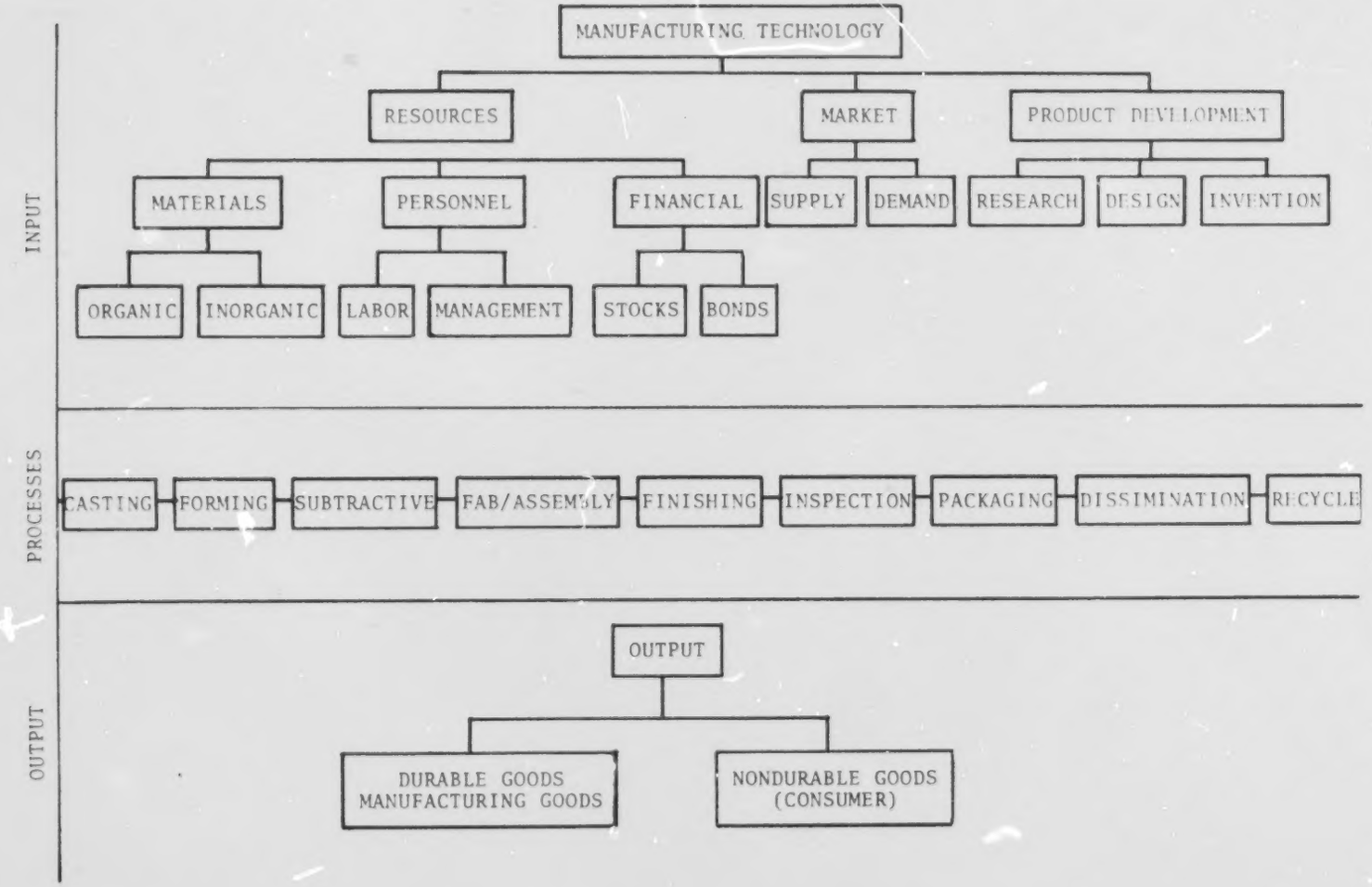
- 1.10 Market
  - 1.11 Demand
  - 1.12 Supply
- 1.20 Resources
  - 1.21 Human
    - 1.211 Management
    - 1.212 Labor
  - 1.22 Materials
    - 1.221 Organic
    - 1.222 Inorganic
  - 1.23 Capital
    - 1.231 Stocks
    - 1.232 Bonds
- 1.30 Product Development
  - 1.31 Engineering
  - 1.32 Designing

2.00 ELEMENTS OF MANUFACTURING

- 2.10 Pre-Processes
  - 2.11 Market survey
  - 2.12 Tooling up for production
  - 2.13 Production prototype
- 2.20 Processing
  - 2.21 Casting
  - 2.22 Forming
  - 2.23 Subtractive
  - 2.24 Fab/Assembly
  - 2.25 Finishing
- 2.30 Post-Processing
  - 2.31 Quality control
  - 2.32 Packaging
  - 2.33 Dissemination
  - 2.34 Recycle

3.00 ELEMENTS OF MANUFACTURING OUTPUT

- 3.10 Non-durable goods
  - 3.11 Consumer goods
- 3.20 Durable goods
  - 3.21 Tools and machines


MANUFACTURING TECHNOLOGY
RESOURCES
MARKET
PRODUCT DEVELOPMENT
MATERIALS
PERSONNEL
FINANCIAL
SUPPLY
DEMAND
RESEARCH
DESIGN
INVENTION
ORGANIC
INORGANIC
LABOR
MANAGEMENT
STOCKS
BONDS
INPUT
PROCESSES
CASTING
FORMING
SUBTRACTIVE
FAB/ASSEMBLY
FINISHING
INSPECTION
PACKAGING
DISSIMINATION
RECYCLE
OUTPUT
OUTPUT
DURABLE GOODS
MANUFACTURING GOODS
NONDURABLE GOODS
(CONSUMER)

MANUFACTURING TECHNOLOGY

BODY OF KNOWLEDGE

1.00 STRUCTURE OF MANUFACTURING INDUSTRY

- 1.10 Four Essentials
  - 1.11 Natural resources
  - 1.12 Capital
  - 1.13 Labor
  - 1.14 Management
- 1.20 Free Enterprise System
- 1.30 Forms of Ownership
  - 1.31 Proprietorship
  - 1.32 Partnership
  - 1.33 Corporation
- 1.40 Labor and Management
  - 1.41 Managerial
  - 1.42 Non-managerial
  - 1.43 Labor relations

2.00 ELEMENTS OF MANUFACTURING

- 2.10 Types of Manufacturing
  - 2.11 Intermittent
  - 2.12 Continuous (mass-production)
- 2.20 Research
- 2.30 Product Design
- 2.40 Product Engineering
- 2.50 Process Engineering
- 2.60 Tooling
- 2.70 Plant Layout
- 2.80 Purchasing
- 2.90 Production Control
- 2.100 Quality Control
- 2.110 Distribution and Service
- 2.120 Personnel Management

3.00 MASS PRODUCTION AND AUTOMATION

- 3.10 Standardization
- 3.20 Tools and Machines
  - 3.21 Jigs
  - 3.22 Fixtures
- 3.30 Material Handling
- 3.40 Assembly Systems
- 3.50 Lead Time and Profit
- 3.60 Automation
- 3.70 Safety

4.00 PRIMARY METALS INDUSTRY

- 4.10 Refining Iron
  - 4.11 Raw materials
  - 4.12 Blast furnace
  - 4.13 Cast iron
- 4.20 Steel
  - 4.21 Open hearth furnace
  - 4.22 Electric Furnace
  - 4.23 Basic oxygen furnace
  - 4.24 Pouring ingote
  - 4.25 Continuous casting
  - 4.26 Rolling mills
- 4.30 Nonferrous Metals
  - 4.31 Aluminum
  - 4.32 Copper
  - 4.33 Lead
  - 4.34 Tin
  - 4.35 Zinc
- 4.40 Alloying
- 4.50 Testing and Research

5.00 CASTING METAL

- 5.10 Patterns and Patternmaking
- 5.20 Core and Core Making
- 5.30 Machine Molding

5.40 Casting Processes
- 5.41 Green sand casting
- 5.42 Die casting
- 5.43 Centrifuged casting
- 5.44 Investment casting
- 5.45 Shell molding
- 5.46 Plaster mold casting

5.50 Cleaning and Finishing

6.00 FORMING METAL

6.10 Forging
- 6.11 Drop forging
- 6.12 Press forging
- 6.13 Cold forging

6.20 Extrusion

6.30 Powder Metallurgy

6.40 Shearing

6.50 Drawing

6.60 Bending

6.70 Roll Forming

6.80 Spinning

6.90 High Energy Rate Forming

7.00 MEASURING AND LAYOUT (ENGLISH AND/OR METRIC)

7.10 Linear Dimension

7.20 Angular Dimension

7.30 Surface Dimension

8.00 MACHINING METAL

8.10 Sawing

8.20 Turning

8.30 Milling

8.40 Shaping

8.50 Drilling

8.60 Grinding

8.70 Recent Techniques

9.00 FASTENING AND FINISHING METAL

9.10 Welding
- 9.11 Arc welding
- 9.12 Oxy-acetylene welding
- 9.13 Resistance welding

9.20 Brazing

9.30 Soldering

9.40 Heat Treating
- 9.41 Annealing
- 9.42 Hardening
- 9.43 Casehardening
- 9.44 Tempering

9.50 Adhesive Bonding

9.60 Sheet Metal Assembly

9.70 Mechanical Fasteners
- 9.71 Threaded
- 9.72 Non-threaded

9.80 Polishing and Buffing

9.90 Coatings
- 9.91 Hot dipping
- 9.92 Electroplating
- 9.93 Organic
  - 9.931 Enamel
  - 9.932 Lacquer

10.00 LUMBERING AND FOREST PRODUCTS

10.10 Characteristics

10.20 Classifications
- 10.21 Hardwoods
- 10.22 Softwoods

10.30 Lumbering
- 10.31 Sawing
- 10.32 Seasoning
- 10.33 Surfacing
- 10.34 Grading

10.40 Plywood

10.50 Hardboard

10.60 Particle Board

11.00 CUTTING AND SHAPING WOOD

11.10 Planing

11.20 Sawing

11.30 Drilling and Boring

11.40 Turning

11.50 Routing and Shaping

11.60 Sanding

11.70 Bending and Laminating

12.00 ASSEMBLING AND FINISHING WOOD

12.10 Wood Joints

12.20 Adhesives

12.30 Mechanical Fasteners
- 12.31 Threaded
- 12.32 Non-threaded

12.40 Assembly Procedures

12.50 Wood Finishes
- 12.51 Coloring
- 12.52 Coating

13.00 PLASTIC MATERIALS AND PROCESSES

13.10 Classification
- 13.11 Thermoplastic plastic
- 13.12 Thermosetting plastic

13.20 Molding
- 13.21 Compression
- 13.22 Transfer
- 13.23 Injection
- 13.24 Plastic foam
- 13.25 Blow

13.30 Extrusion

13.40 Thermoforming

13.50 Casting

13.60 Fabricating and Finishing

14.00 CAREER OPPORTUNITIES IN MANUFACTURING

14.10 Levels of Employment
- 14.11 Professional
- 14.12 Skilled
- 14.13 Semi-skilled
- 14.14 Unskilled

14.20 Personnel Practices
- 14.21 Recruiting
- 14.22 Hiring
- 14.23 Training
- 14.24 Working
- 14.25 Advancement
- 14.26 Retirement

14.30 Outlook

MANUFACTURING TECHNOLOGY

MAJOR UNITS

1.00	STRUCTURE OF INDUSTRY	3 Days
2.00	ELEMENTS OF MANUFACTURING	5 Days
3.00	MASS PRODUCTION AND AUTOMATION	8 Days
4.00	PRIMARY METALS INDUSTRY	3 Days
5.00	CASTING METAL	5 Days
6.00	FORMING MATERIALS	8 Days
7.00	MEASURING AND LAYOUT (ENGLISH AND/OR METRIC)	2 Days
8.00	MACHINING AND FINISHING METAL	8 Days
9.00	FASTENING AND FINISHING METAL	8 Days
10.00	LUMBERING AND FOREST PRODUCTS	3 Days
11.00	CUTTING AND SHAPING WOOD	15 Days
12.00	ASSEMBLING AND FINISHING WOOD	10 Days
13.00	PLASTIC MATERIALS AND PROCESSES	10 Days
14.00	OPPORTUNITIES IN MANUFACTURING	2 Days

UNIT I

1.00 STRUCTURE OF MANUFACTURING INDUSTRY 3 Days

OBJECTIVE: At the end of this unit, the student will be able to:

1. Identify the four essentials of the manufacturing industry.
2. List and explain the three forms of ownership.
3. Give examples of long-range and short range planning that families do.

UNIT OUTLINE

1.10 Four Essentials
- 1.11 Natural resources
- 1.12 Capital
- 1.13 Labor
- 1.14 Management

1.20 Free Enterprise System

1.30 Forms of Ownership
- 1.31 Proprietorship
- 1.32 Partnership
- 1.33 Corporation

1.40 Labor and Management
- 1.41 Managerial
- 1.42 Non-managerial
- 1.43 Labor relations

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapters 1 and 2.

REFERENCE: Lux, Donald G., Willis E. Ray, and H. Dean Hauenstein, THE WORLD OF MANUFACTURING, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1971. Chapters 1--8

UNIT NO. I	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
1.00	STRUCTURE OF MANUFACTURING THE STUDENT WILL BE ABLE TO:	
1.10	A. Identify the four manufacturing elements.	A1. The students will discuss the four essentials of specific manufacturing industries. Examples: the auto industry, the boat industry and the sugarbeet industry.
1.20	A. Demonstrate the principle of supply and demand.	A1. The student will state how the demand for a product affects the supply. Example: the price of coffee, sugar, gasoline.
1.30	A. Name and explain the three forms of ownership.	A1. The student will discuss the advantages and disadvantages of the different types of ownership. Example: tax benefits, financing, legal implications (have a local lawyer talk to class).
1.40	A. Demonstrate the relationship between labor and management.	A1. The student will identify several planning, organizing, and controlling functions of management for manufacturing. Example: Assign students to management role-playing. A2. The student will identify several of the working activities necessary for manufacturing a specified product. Example: Assign students to labor role-playing.

UNIT II

2.00 ELEMENTS OF MANUFACTURING 5 Days

OBJECTIVES: At the end of this unit the student will be able to:

1. List and describe several leadership positions in the manufacturing industry.
2. State what you could do, as a consumer, if a company's products became poorer in quality than you wanted them to be.

UNIT OUTLINE

2.10 Types of Manufacturing

- 2.11 Intermittent
- 2.12 Continuous (mass production)

2.20 Research

2.30 Product Design

2.40 Product Engineering

2.50 Process Engineering

2.60 Tooling

2.70 Plant Layout

2.80 Purchasing

2.90 Product Control

2.100 Quality Control

2.110 Distribution and Service

2.120 Personnel Management

TEXT: Wagner, Willis, H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapters 1 and 2.

REFERENCE: Lux, Donald G., Willis E. Ray, and H. Dean Hauenstein, THE WORLD OF MANUFACTURING, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1971. Chapters 9--33.

UNIT NO. II	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
2.00	ELEMENTS OF MANUFACTURING THE STUDENT WILL BE ABLE TO:	
2.10	A. List and describe several leadership positions in manufacturing.	A1. The student will identify the line and staff organization of a corporation designed to manufacture a specified product. Example: set up corporation for salt and pepper shaker or similar product.
2.20	A. Become a wise consumer.	A1. The student will discuss ways in which he may become a wise consumer. Example: what to buy in terms of durability, servicing, economical, and re-sale.

UNIT III

3.00 MASS PRODUCTION AND AUTOMATION 8 Days

OBJECTIVES: At the end of this unit the student will be able to:

1. Define automation and list the reasons and principles of automation.
2. Be informed of importance of cost estimating.
3. Use a managed production system.

UNIT OUTLINE

3.10 Standardization

3.20 Tools and Machines

- 3.21 Jigs
- 3.22 Fixtures

3.30 Material Handling

3.40 Assembly Systems

3.50 Lead Time and Profit

3.60 Automation

3.70 Safety

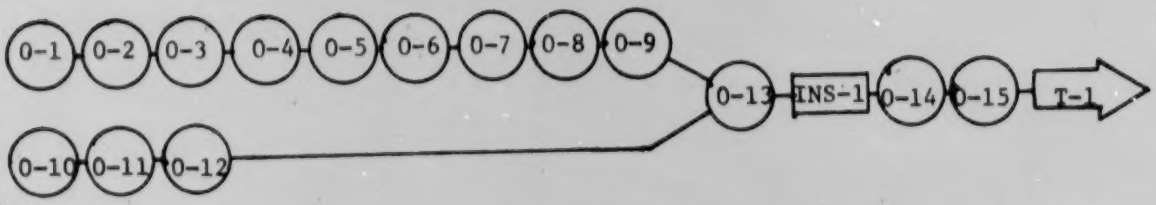
TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 4.

REFERENCE: Lux, Donald G., Willis E. Ray, and H. Dean Hauenstein, THE WORLD OF MANUFACTURING, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1971. Chapters 9--33

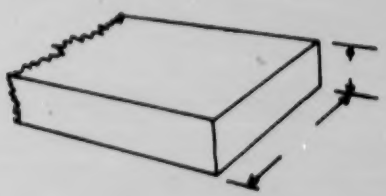
UNIT NO. III	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
3.00	MASS PRODUCTION AND AUTOMATION THE STUDENT WILL BE ABLE TO:	
3.10	A. Define automation and list the reasons and principles of automation.	A1. The student will fabricate a coat hanger without the use of jigs or fixtures. Example: refer to p. 7 IACP World of Manufacturing Lab Manual.
3.20	A. Define the elements of mass production.	A1. The student will produce a coat hanger with the use of jigs and fixtures. Example: refer to p. 9--13 IACP World of Manufacturing Lab Manual.
3.30	A. Use a managed production to produce a product.	A1. Using line and staff development from a previous exercise, the student will manufacture a specified product under safe working conditions. Example: salt and pepper shakers, tie rack, tic-tac-toe game and others.

3.2

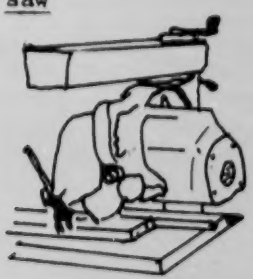
TIC-TAC-TOE MANUFACTURE



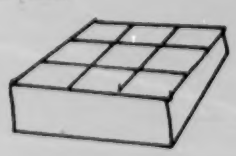
0-1 Surface stock to size with a planer



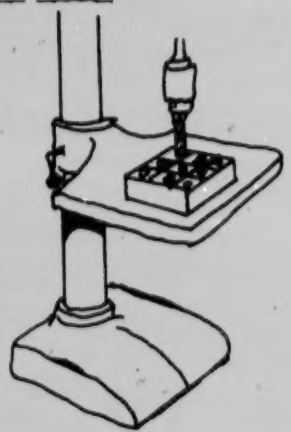
0-2 Cut to length with a radial arm saw



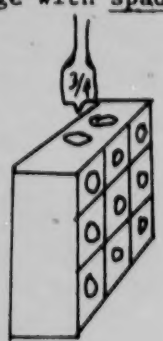
0-3 Cut dados and grooves with table saw



0-14 Drill marble holes with twist drill



0-5 Bore holes for marble storage with spade drill



O-6 Cut groove with router

O-7 Bevel edges of wooden block with disk sander

O-8 Sand wooden block with orbital sander

O-9 Hand sand and apply oil finish to wooden block

O-10 Shear plastics slide to size with squaring shears

O-11 Cut slot in plastics slide with router

O-12 Finish the slide edges with a disc sander

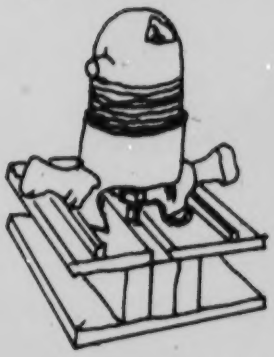
O-13 Assemble slide to wooden block with an ornamental wood screw

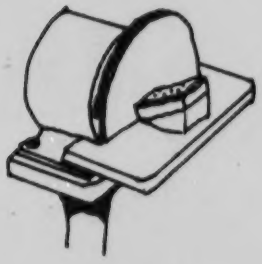
INS-1 Inspect manufacturing quality

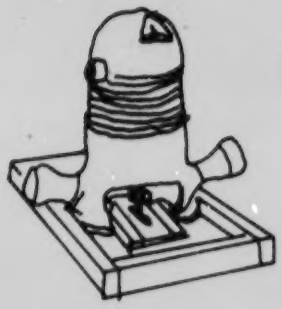
O-14 Load two sets of marbles, four marbles in each set

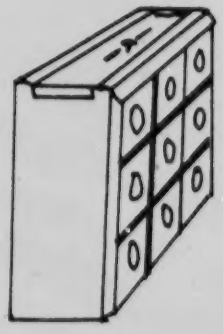
O-15 Package Tic-Tac-Toe product

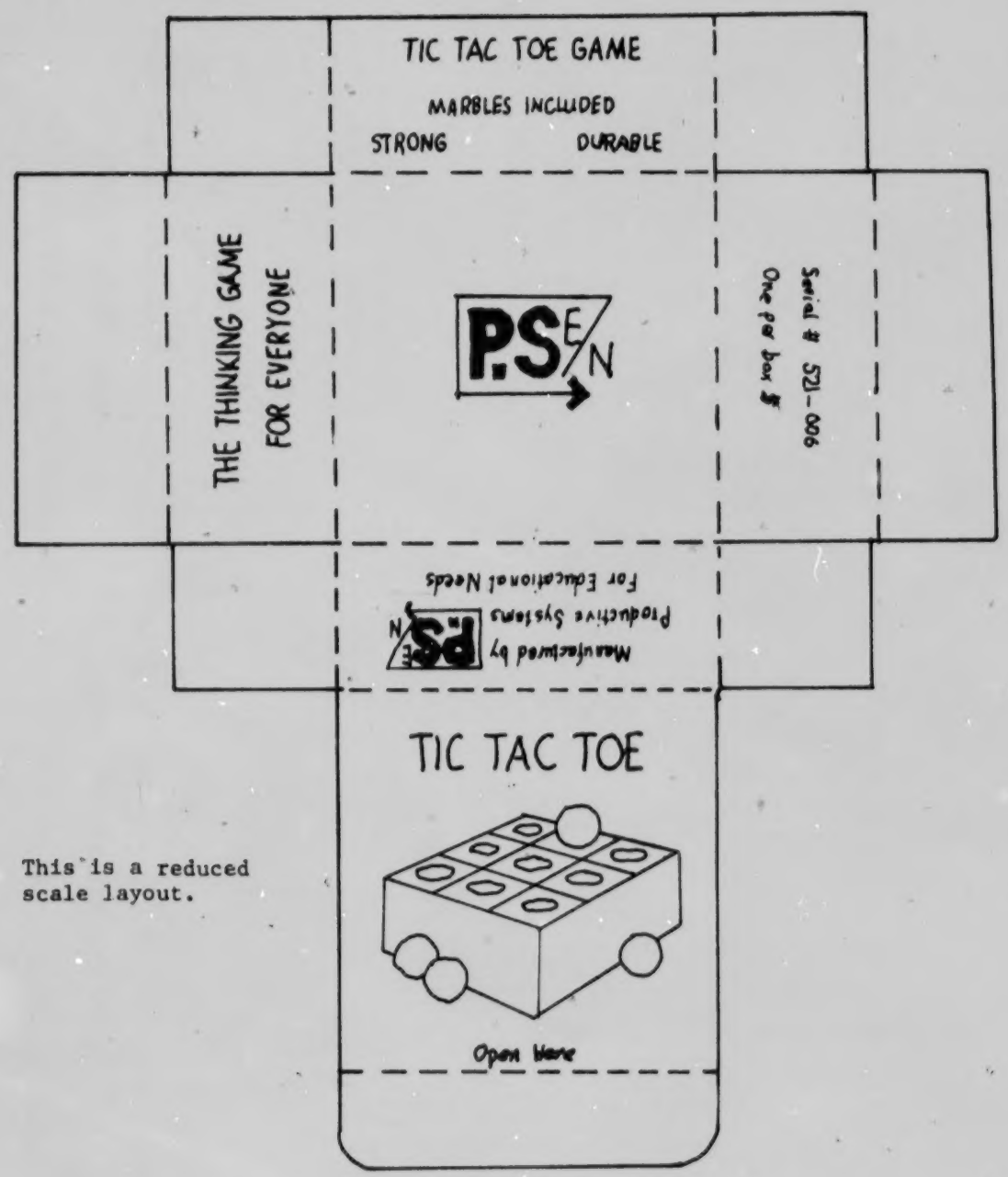
T-1 Distribute the product







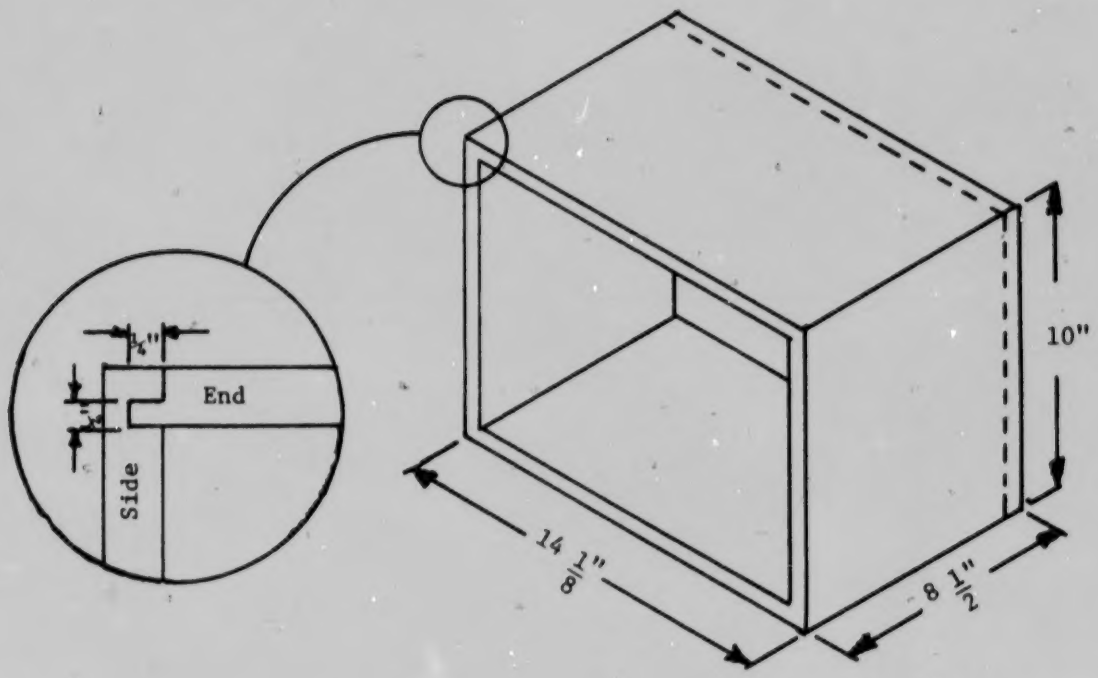




This is a reduced scale layout.

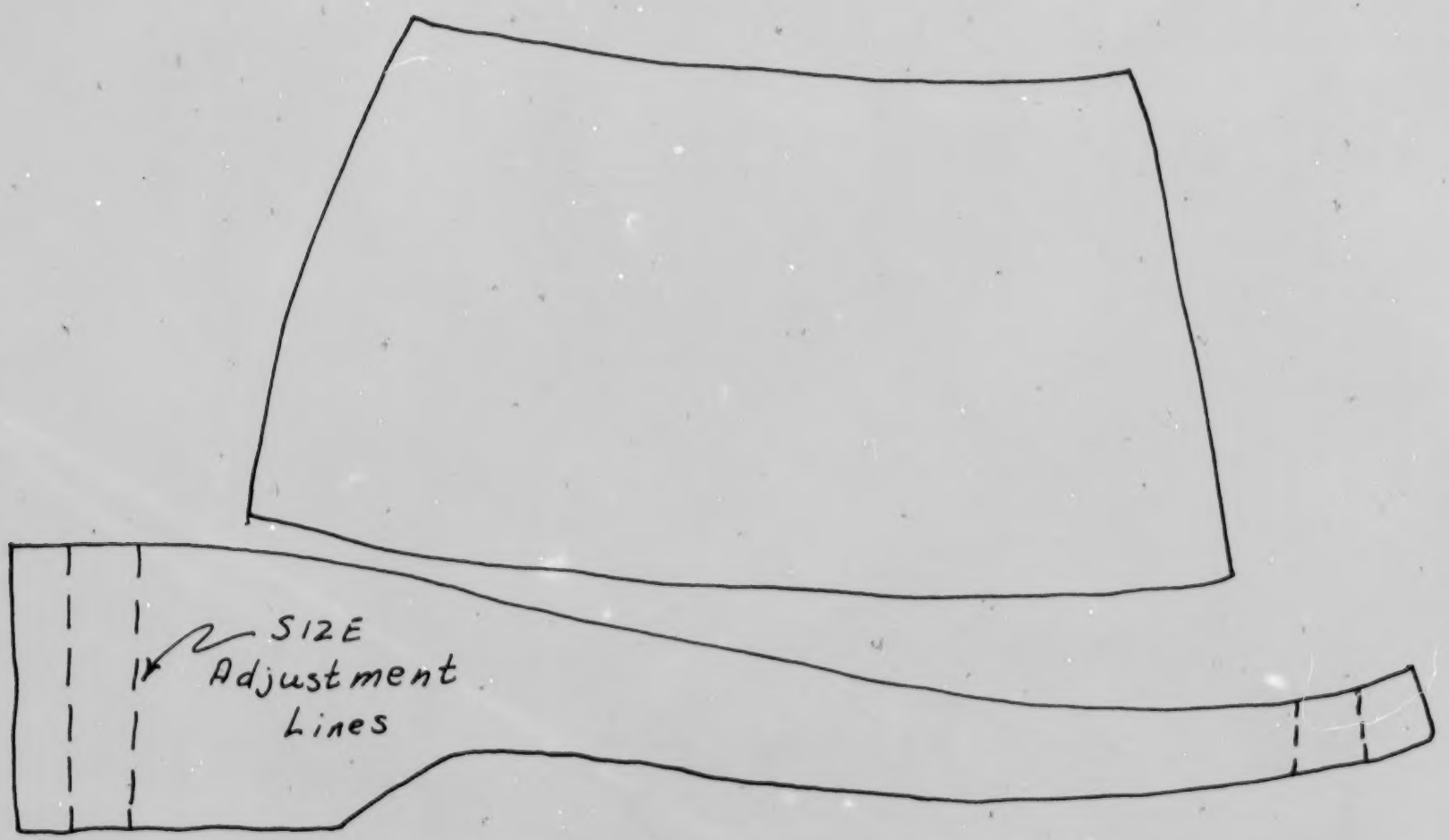
CONSTRUCTING THE CHESS CABINET

MATERIALS NEEDED: ½" fir plywood (sound 2 sides)
1" x 9" Philippine mahogany (rough dimensions)
3 penny finish nails
Wood grain decorative laminate
¼" tempered hardboard (Masonite)
White vinyl glue



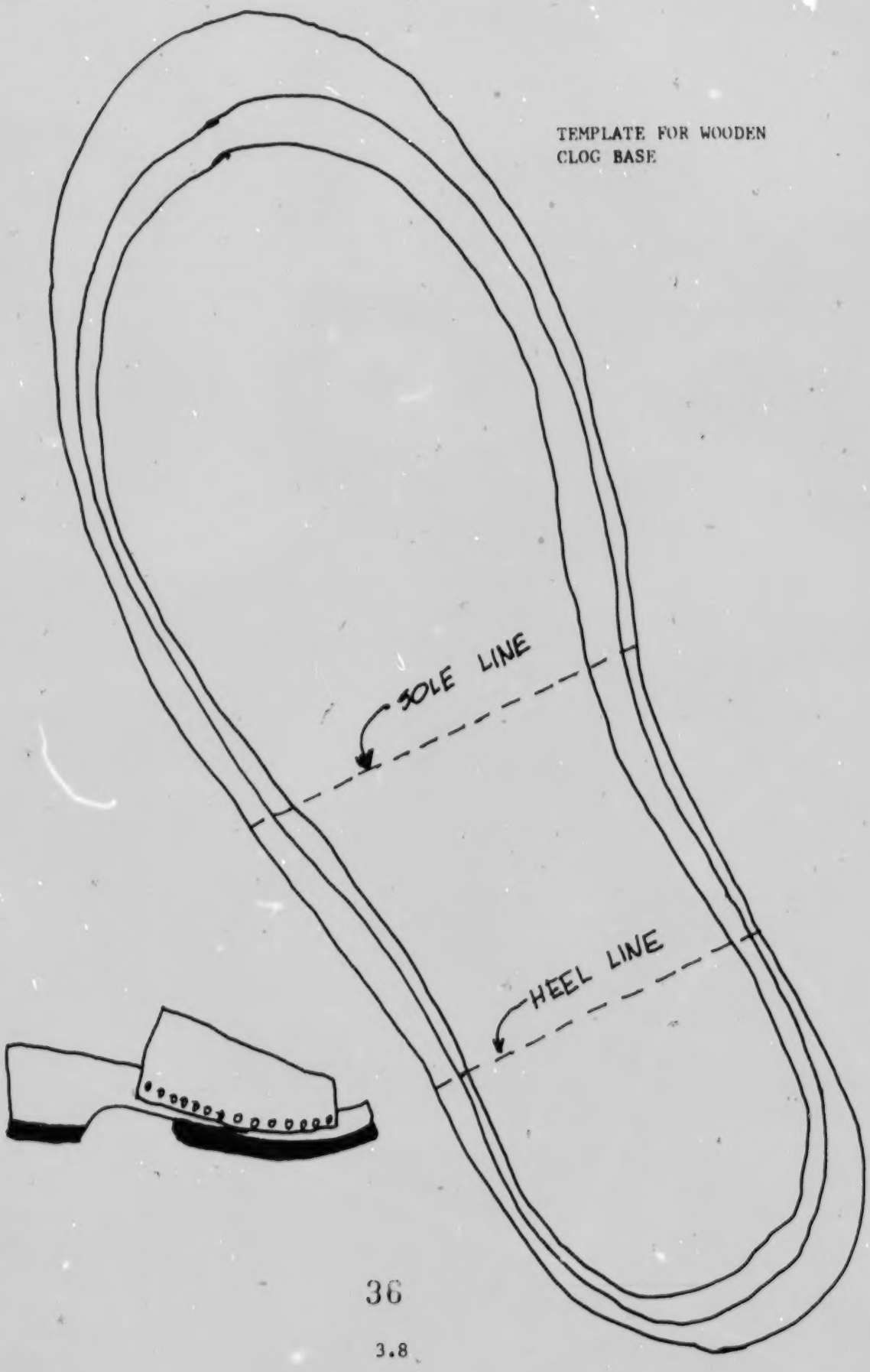
MAHOGANY PREPARATION

1. Surface stock to ½" thickness with surfacer.
2. Plane one edge with a jointer.
3. Rip to 8½" width with circular table saw.
4. Cut ends (9½"_ and sides (14 1/8") to length with radial arm saw.
5. Cut rabbet and dado joints (¼" x ¼") with circular table saw.



3.7

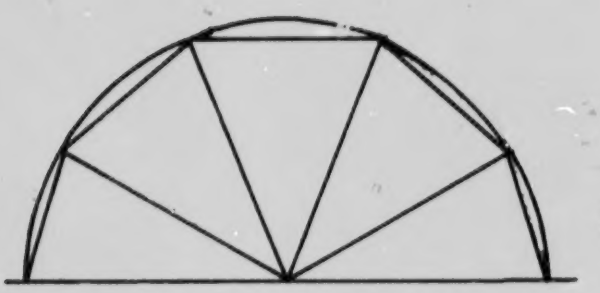
TEMPLATE FOR WOODEN
CLOG BASE



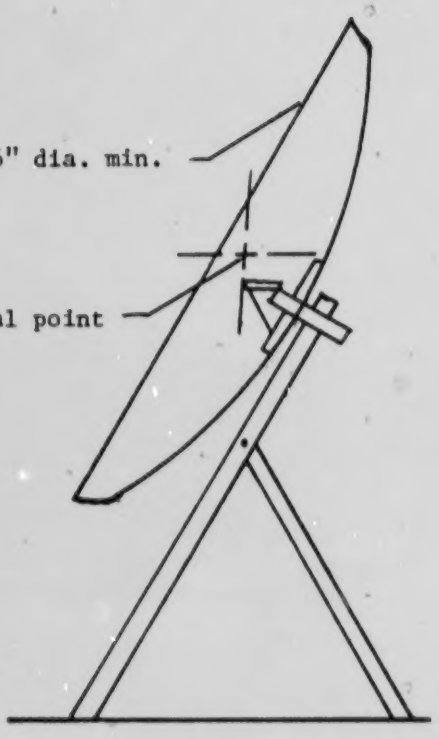
PORTABLE SOLAR STOVE

Design a Portable Solar Stove (using the design procedure given you) suitable for survey parties and campers, for use in relatively sunny climates. It must be lightweight and disassembled to pack into a small box. A parabolic reflector at least three feet in diameter must be used, and its focal point must not be too precise or it will tend to burn a hole in a small container. The reflector must be on an adjustable mounting so that it can be focused on the sun at different times of the day and year, and at different latitudes.

The suggested solution consists of a reflector made of eight properly developed segments of polished sheet metal. These segments lie flat when not in use, and are bent to the proper shape by fasteners holding the segment edges together.



Development of three segments of eight segments reflector - suitable fasteners will pull flat pieces to parabolic curve.

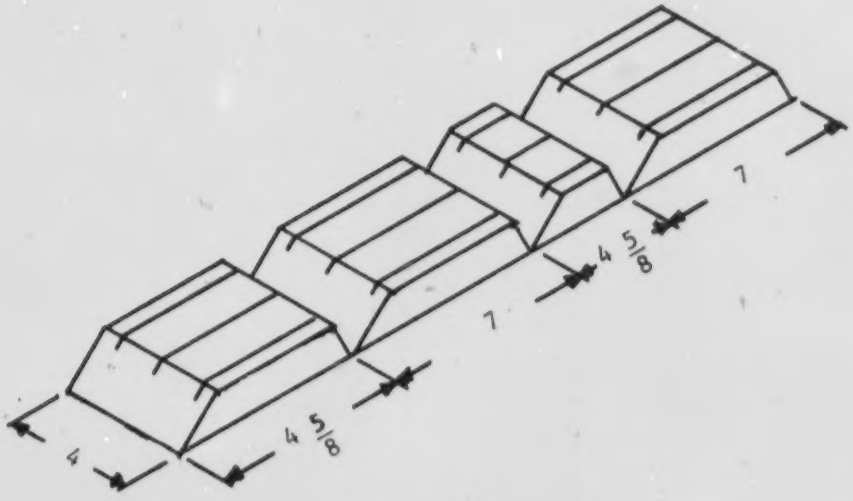


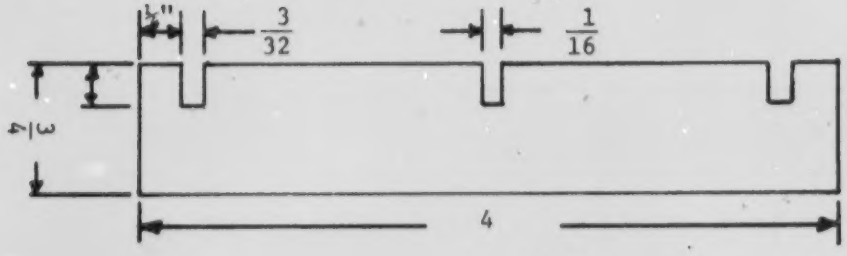
Section through parabolic reflector

OPTICAL LAMP HOUSING

MATERIALS NEEDED:
1 pc. 24 x 4 x 3/4 white pine
1 pc. vinyl contact paper 12" x 24"
4 #8 F.H. woods screws, 5/8 inch
1 #8 F.H. wood screw, 1¼ inch
Polyvinyl glue
1 pc. clear glazing 3/32" x 3½" x 6"
1 pc. synthetic stained glass 3/32" x 3½" x 6"
4 rubber or plastic feet

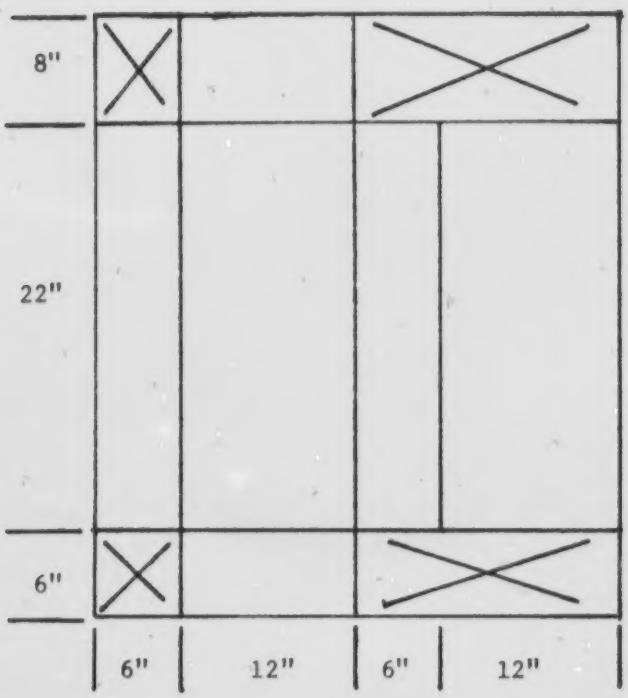
PROCEDURE:
1. Cut core stock to length
2. Cut grooves in core stock
3. Seal core stock with sanding sealer. Sand lightly when dry.
4. Cover core stock with contact paper
5. Lay out and mark joint cuts
6. Drill holes for cord
7. Cut joints
8. Install printed circuit board
9. Install plug
10. Install glass and fold box together
11. Install locking screw #8 x 1¼"
12. Install feet





CLOTH BACK PACK

1. Select colorful denim fabric--a 36" x 36" piece is required.
2. Layout pattern with a hardboard template by rubbing chalk over the perforated areas.
3. Use scissors to cut away X portions.
4. Sew pattern by hand or machine.
5. Attach nylon webbing straps with rivets.
6. Attach any pockets, buttons, snaps, or patches to meet the individuals needs.



CHESS CABINET

BOTTOM CONSTRUCTION

1. Cut ½" fir plywood (9" x 13 1/8") - make three pieces. Be sure to cut identical pieces with square corners.

GLUING AND CLAMPING

1. Trial assemble ends, sides, and one plywood bottom. Work out clamping procedure with plywood bottom being flush (even) with the opening.

2. Disassemble and spread glue all joint areas. Use white vinyl glue.

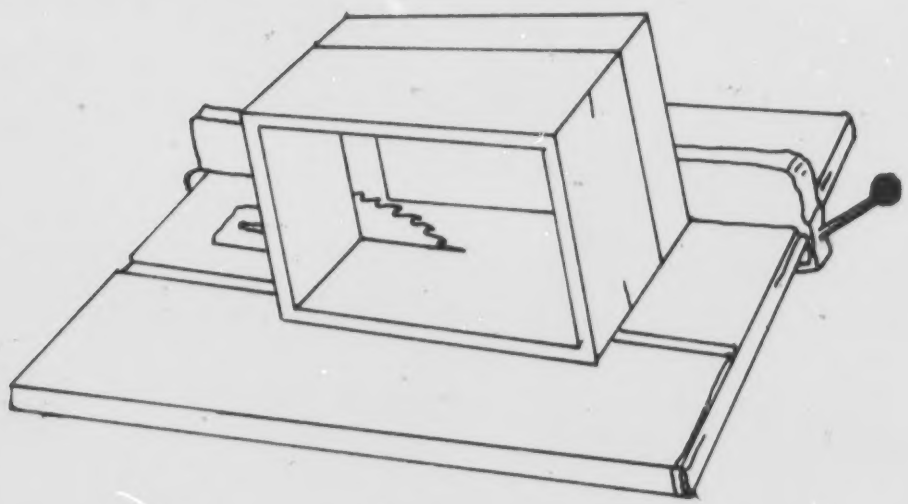
3. Clamp the ends, sides, and bottom with bar clamps and nail bottom with two 3-penny finish nails on each of the four surfaces.

SECTIONING THE BOX

1. After the glue has dried, remove the clamps.

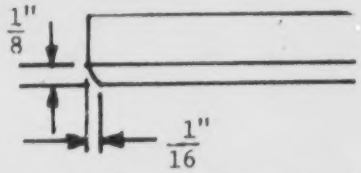
2. Clean up the box with a belt sander, making sure to blend the joint areas.

3. Separate the box into three sections with the table saw. The bottom is to be 2½" deep and each of the two upper sections is to be 2 3/4" deep.

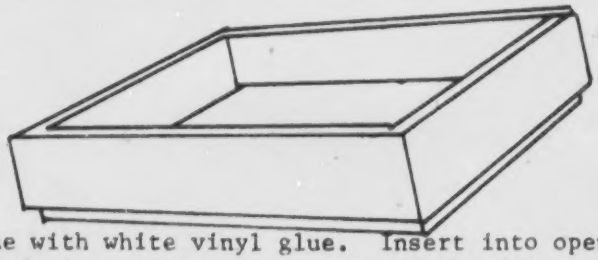


PLACING BOTTOMS INTO UPPER SECTIONS

1. Chamfer (1/8" x 1/16"), using a disc or belt sander, lower edge of the remaining two pieces of plywood.



2. Insert each piece into its corresponding section by leaving the chamfer face protruding 1/8" beyond the section opening. Do this before applying any glue.



3. Remove bottoms and glue with white vinyl glue. Insert into opening to the desired depth and place two nails in each of the four surfaces.

4. Set all nails with a nail set.

5. Fill nail holes with wood putty.

FINISHING THE CHESS CABINET

1. Hand sand the cabinet on the outer sides and ends thoroughly, but only moderately on the inside.

2. Rub on an oil finish on the outside only.

3. Glue in polystyrene foam liners with white vinyl glue.

4. Brush coat the inside of each section with slow drying colored paint. Match the paint color with the flocking you have chosen.

5. Dump flocking into each section while the paint is still wet and place a plywood sheet over the box; shake the box vigorously in all directions.

6. Remove plywood sheet and dump out all excess flocking. Save the excess flock.

CHECKERBOARD CONSTRUCTION

MATERIALS NEEDED: .060" ABS plastics - white and black textured sheets
1/8" tempered hardboard
Contact vinyl paper with simulated wood grain
2" wide cloth air-conditioning tape (duct tape)
Contact cement for tile adhesion

PROCEDURE

1. Saw 1/8" hardboard 6 1/2" x 13". You will need two pieces.

2. Shear plastics sheet into 1 5/8" squares. You will need 32 white and 32 black squares. Be sure all pieces are square.

3. Lightly sand all surfaces to be bonded with fine sandpaper and wipe clean with alcohol.

4. Apply contact cement as instructed by the container label.

5. Place plastic squares into position carefully.

6. Place the two board halves together in an upside-down position and apply one strip of duct tape along the joint.

7. Cover the entire back with contact vinyl.

UNIT IV

4.00 PRIMARY METALS INDUSTRY 3 Days

OBJECTIVES: At the end of this unit the student will be able to:

1. Have an understanding of refining and processing of iron and steel.
2. Distinguish between ferrous and nonferrous metals.
3. Understand metal testing and research.

UNIT OUTLINE

4.10 Refining Iron

- 4.11 Raw materials
- 4.12 Blast furnace
- 4.13 Cast iron

4.20 Steel

- 4.21 Open hearth furnace
- 4.22 Electric furnace
- 4.23 Basic oxygen furnace
- 4.24 Pouring ingots
- 4.25 Continuous casting
- 4.26 Rolling mills

4.30 Nonferrous metals

- 4.31 Aluminum
- 4.32 Copper
- 4.33 Lead
- 4.34 Tin
- 4.35 Zinc

4.40 Alloying

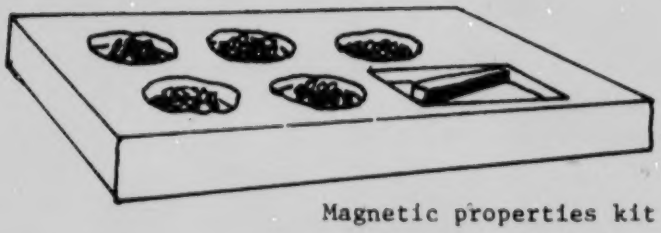
4.50 Testing and Research

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 5.

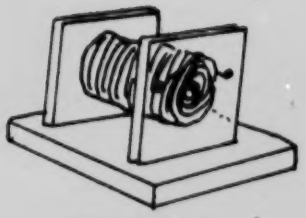
UNIT NO. IV	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
4.00	PRIMARY METALS INDUSTRY THE STUDENT WILL BE ABLE TO:	
4.10	A. Identify the materials and processes used to manufacture iron and steel.	A1. The student will view a film strip entitled "How Steel is Made." U.S.S.
4.20	A. Name and identify ferrous and nonferrous metals.	A1. The student will identify various shapes of metal available within the laboratory. Example: sample metal pieces--kinds, shapes, etc.
4.30	A. Explain the purpose of alloying metals.	A1. The student will discuss how a selected number of metals are refined and identified. Example: harness test--file, grinder spark test. A2. See A1. above.
4.40	A. List and identify metal testing devices and how they may be applied to research.	A1. The student will experience various distructive and non-distructive forms of metal testing. Examples: testing with vise and monkey wrench, hammer, jack.

4.3

MAGNETIC PROPERTIES OF METAL



Magnetic properties kit



magnetizing coil

Experiment #1

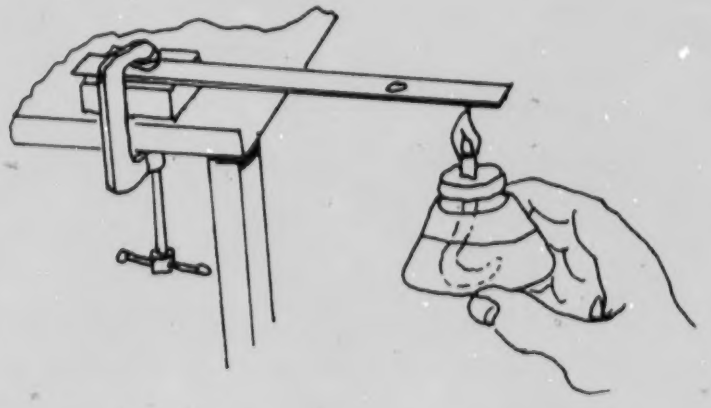
Using samples of different metals provided in the class, take a permanent magnet and see which metals have magnetic properties. List the metals under the three terms used to classify metals as to their ability to be magnetized.

Experiment #2

Using a permanent magnet, pick up as many thumbtacks as the magnet will hold. Remove the thumbtacks and strike the magnet sharply with a hammer. Now try and pick up the same number of thumbtacks. Can they all be picked up? Why? You may remagnetize the bar of steel with an electrical coil and a direct current source.

Experiment #3

Clamp a Monel strip to a table and place a button magnet about an inch from the end. Using an acohol burner, heat the Monel strip. The button magnet will move away from the heat. This is because the curie temperature is about 150°F and Monel will lose its magnetic properties.



TESTING THERMAL CONDUCTIVITY AND EXPANSION OF METALS

Supplies:
- 4 inch lengths of 1/8" brass, aluminum, steel, and phenolic rod
- Candle or beeswax
- Alcohol burner
- Magnetizing coil
- 4 inch "C" clamp
- One pound tinners rivets
- Thermal conductivity testing structure
- Magnetic properties kit
- Monel strip
- 20-28 gauge x ½" x 5" mild steel and brass strips
- Hand lever hole punch
- Micrometer
- .080" - .100" soft copper wire
- Wire drawing die
- Ball peen hammer
- ¼" diameter x 2" aluminum and low carbon steel

Equipment:
- Soldering furnace or torch for annealing
- Machinist vise

UNIT V

5.00 CASTING METAL 5 Days

OBJECTIVE: At the end of this unit, the student will become familiar with the casting or molding processes.

UNIT OUTLINE

5.10 Patterns and Patternmaking

5.20 Core and Core Making

5.30 Machine Molding

5.40 Casting Processes

- 5.41 Green sand casting
- 5.42 Die casting
- 5.43 Centrifugal casting
- 5.44 Investment casting
- 5.45 Shell molding
- 5.46 Plastic mold casting

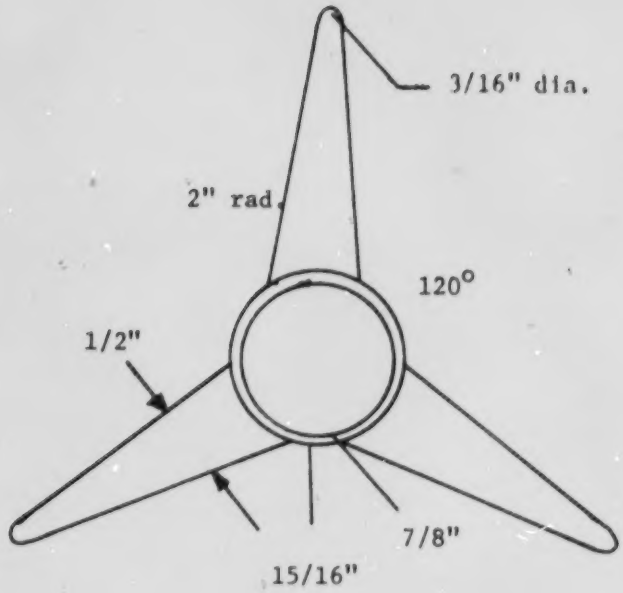
5.50 Cleaning and Finishing

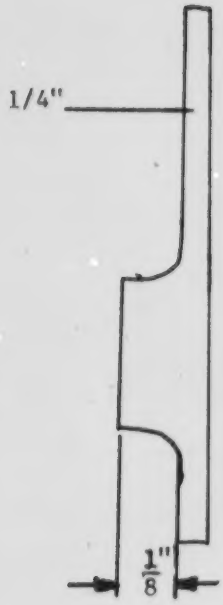
TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 6.

UNIT NO. V	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
5.00	CASTING METALS THE STUDENT WILL BE ABLE TO:	
5.10	A. Fabricate products requiring pattern making.	A1. The student will cast, clean, and finish a selected product on subassembly.
5.20	A. Explain and perform selected casting processes.	A1. See A1. above.
5.30	A. Explain the cleaning and finishing operations leading to a completed product as done in industry.	A1. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced. Examples: Permanent mold casting--fishing sinkers. Flat pattern casting--name plate on plaque. Split pattern--hammerhead or anvil. Investment casting--wax or styrofoam mold.

5.2

PAPERWEIGHT





PRODUCT DEVELOPMENT

Lead Weight
1. Introduce the idea
2. Construct hard mockup
3. Plaster splash (Female mold)
4. Ram and cast permanent mold of aluminum (Green sand or shell mold)

Ball
1. Introduce to plastics casting (polyester)
2. Mix polyester resin and catalyst
3. Pour into flasks (glass)
4. Add decorative systems (color, glitter)
5. Cure parts
6. Remove from mold (greak glass flask)

Assembly
1. Position ball on base
2. Bend prongs into position

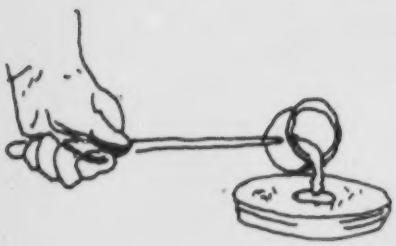
FORMING MATERIALS

A. Mold surface texture

pattern
(large coin)

jar lid
3" - 4"
diameter

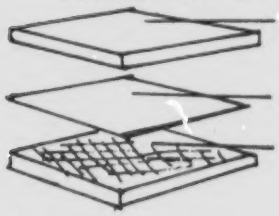
1. Push pattern into sand and remove



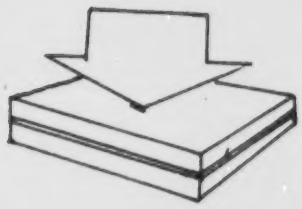
2. Pour hot lead into mold cavity

B. Embossed surface

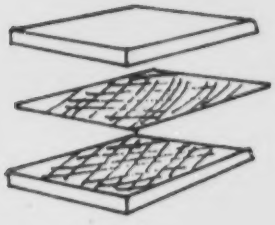
heavy gauge x 2 " x 4"
aluminum foil



1. Place aluminum foil between die and rubber punch



2. Closed under pressure of vise or hydraulic press



finished part

3. Open and remove part

UNIT VI

6.00 FORMING MATERIALS 8 Days

OBJECTIVES: At the end of this unit, the student will be able to explain the major ways to form stock.

UNIT OUTLINE

6.10 Forging

6.11 Drop forging

6.12 Press forging

6.13 Cold forging

6.20 Extrusion

6.30 Powder Metallurgy

6.40 Shearing

6.50 Drawing

6.60 Bending

6.70 Roll Forming

6.80 Spinning

6.90 High Energy Rate Forming

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 7.

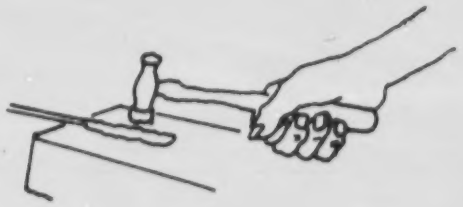
UNIT NO. VI	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
6.00	FORMING MATERIALS (METAL, PLASTIC, WOOD, ETC.) THE STUDENT WILL BE ABLE TO:	
6.10	A. Explain selected forming processes.	A1. The student will explore selected processes through simulated activities. Example: mold a ball of clay into a vessel to hold water.
6.20	A. Fabricate products under simulated conditions.	A1. The student will through forming methods fabricate a product or sub-assembly. Example: wrought iron decorations, sheet metal box or tray, bending stakes for animal traps, etc. A2. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced. Example: write how the product could be mass produced.

6.2

THE EFFECTS OF COLDWORKING AND ANNEALING

Experiment #1 - Cold working by hammering

Take a copper wire (6" - 8", .080" - .100" diameter) and hammer one end of the rod flat. Check the comparative strength of the hammered end versus the regular end by trying to bend each end of the rod by hand. The hammered end should be more difficult to bend.



Experiment #2 - Annealing

Use the copper rod prepared in experiment #1. Heat the hammered end of the rod to approximately 600°F. After cooling in water, try the same test used previously. How does the stiffness compare? The annealing process will have softened the rod after the cold working has hardened it.

Experiment #3 - Cold working by drawing wire

Cut off two pieces of .069 copper wire about six inches long. File a taper on one rod so that it goes through the largest hole in the draw plate. Using pliers and oiling the rod before each drawing, pull the rod through the largest hole. By bending, compare the stiffness to the other piece of undrawn copper wire. Anneal (heating to approximately 600°F) the piece of copper wire that had been drawn through the next hole; compare the two wires by bending. Which has more resistance to bending? Why? Oil the same wire and draw it through the next hole. By bending, compare its stiffness to the first copper wire; one might expect the thinner wire to bend more easily. Does it?

UNIT VII

7.00 MEASURING AND LAYOUT (ENGLISH AND/OR METRIC) 2 Days

OBJECTIVES: At the end of this unit, the student will become familiar with the English and/or metric measuring and layout system.

UNIT OUTLINE

7.10 Linear Dimension

7.20 Angular Dimension

7.30 Surface Dimension

7.40 Volume

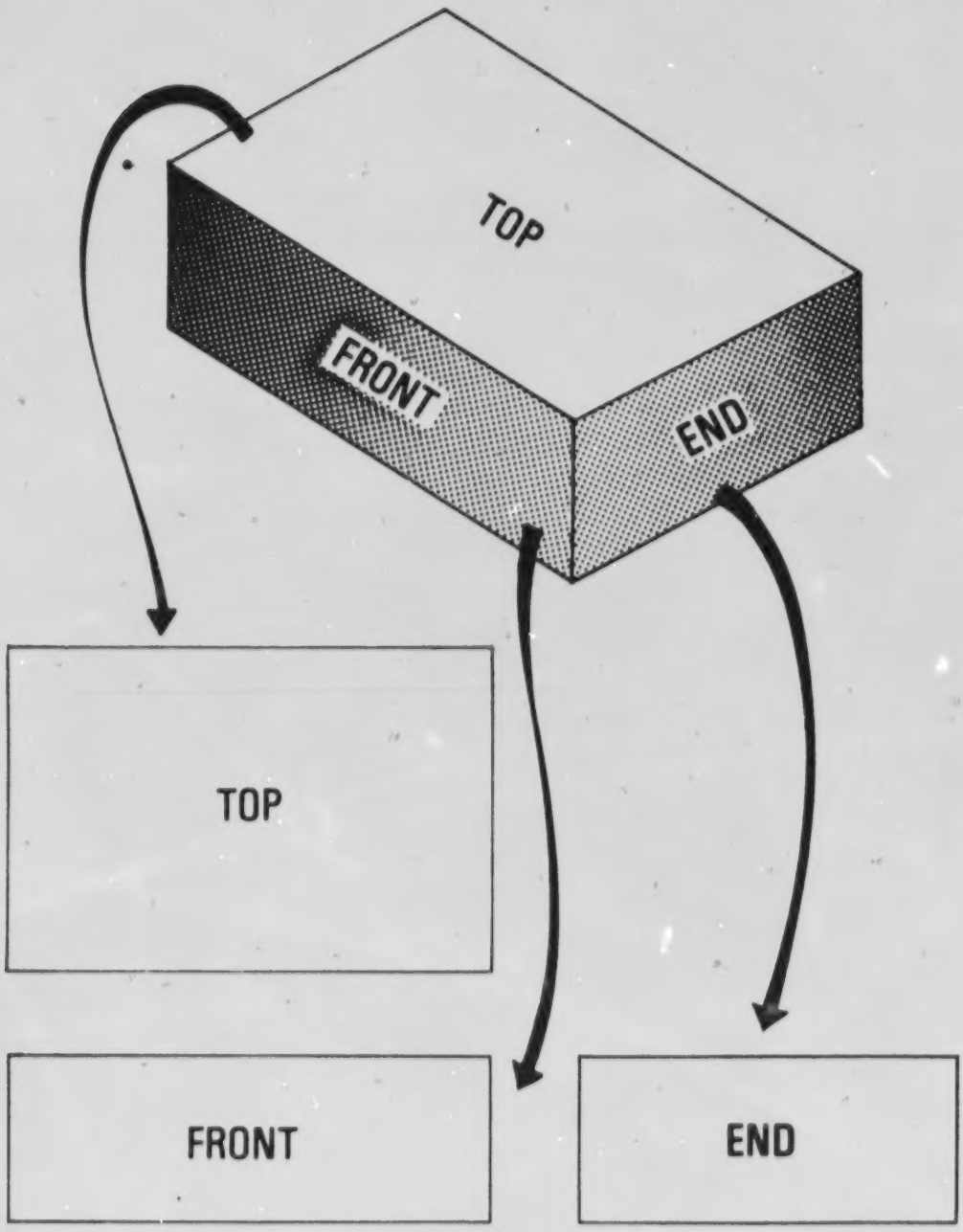
7.50 Weight

REFERENCE: Use existing materials and included transparencies.

UNIT NO. VII	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
7.00	MEASURING AND LAYOUT (ENGLISH AND/OR METRIC) THE STUDENT WILL BE ABLE TO:	
7.10	A. Take measurments in standard units.	A1. The student will measure selected objects in specified units.
7.20	A. Name and identify standard measuring tools.	A1. The student will identify standard measuring tools. Example: steel rule, wire gauge, calipers, micrometer, steel tape, protractor, vernier calipers, circumference rule, measuring cup, seale/balance graduate.

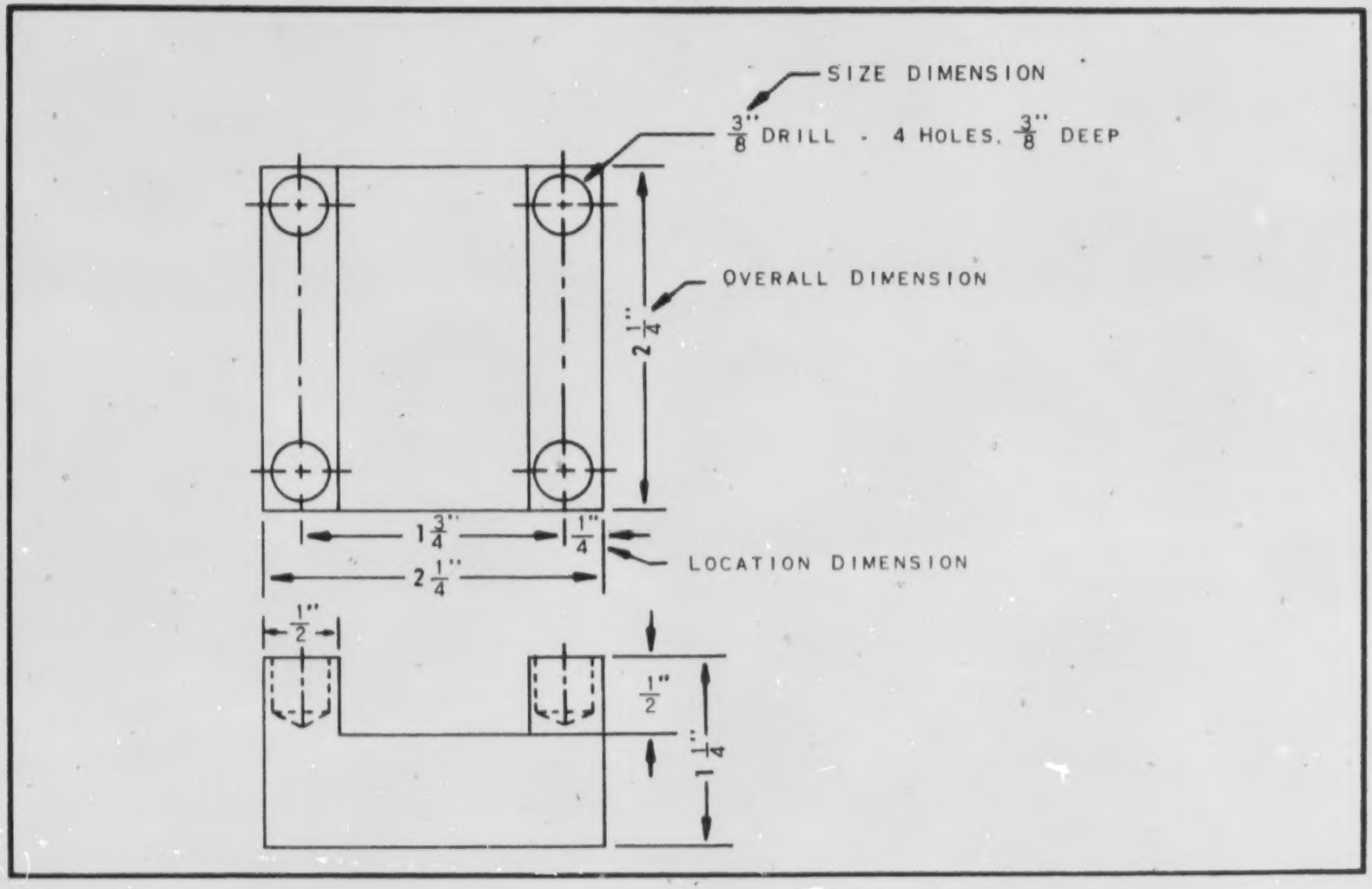
7.2

CONVERTING A PICTORIAL VIEW INTO A 3-SIDED VIEW



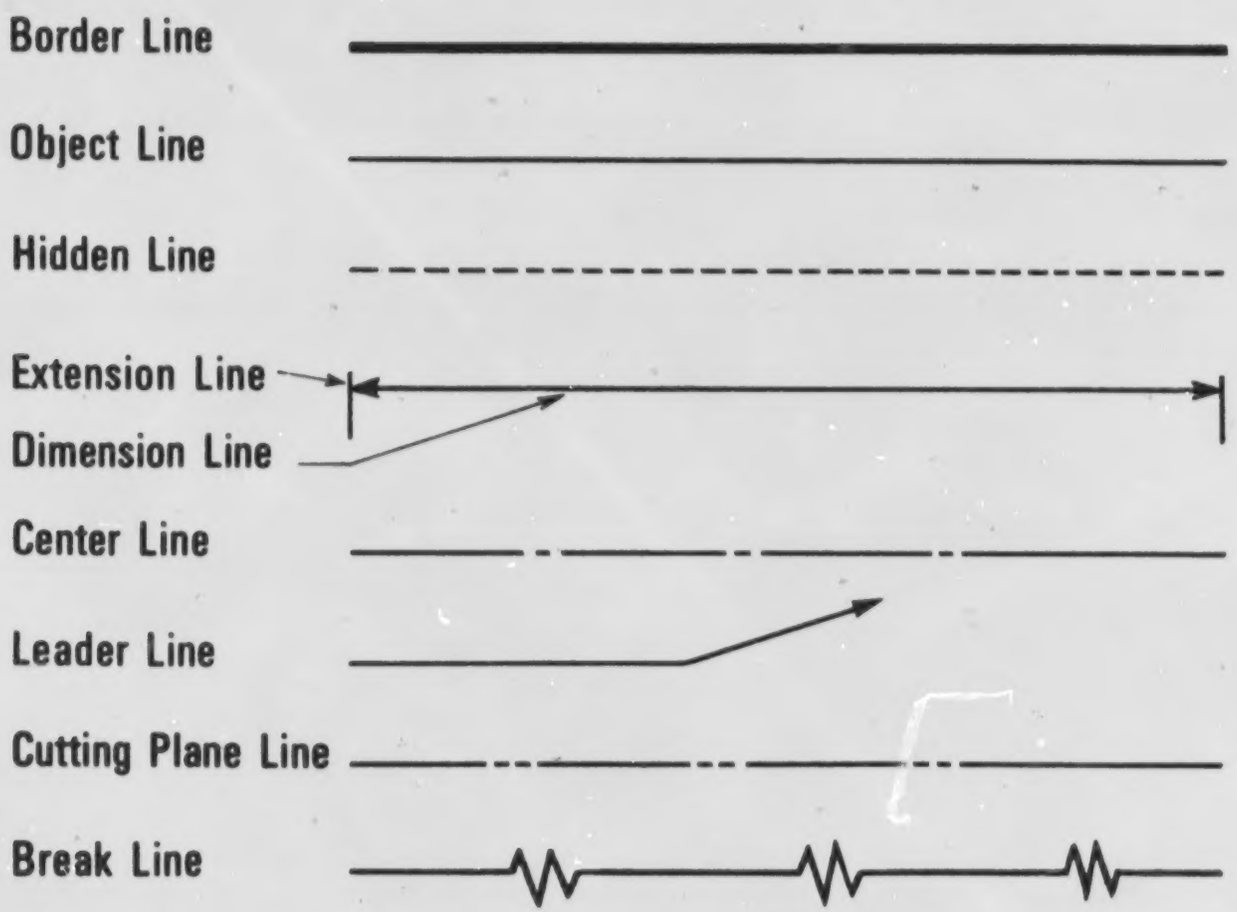
7.3

TYPES OF DIMENSIONS ON A BLUEPRINT



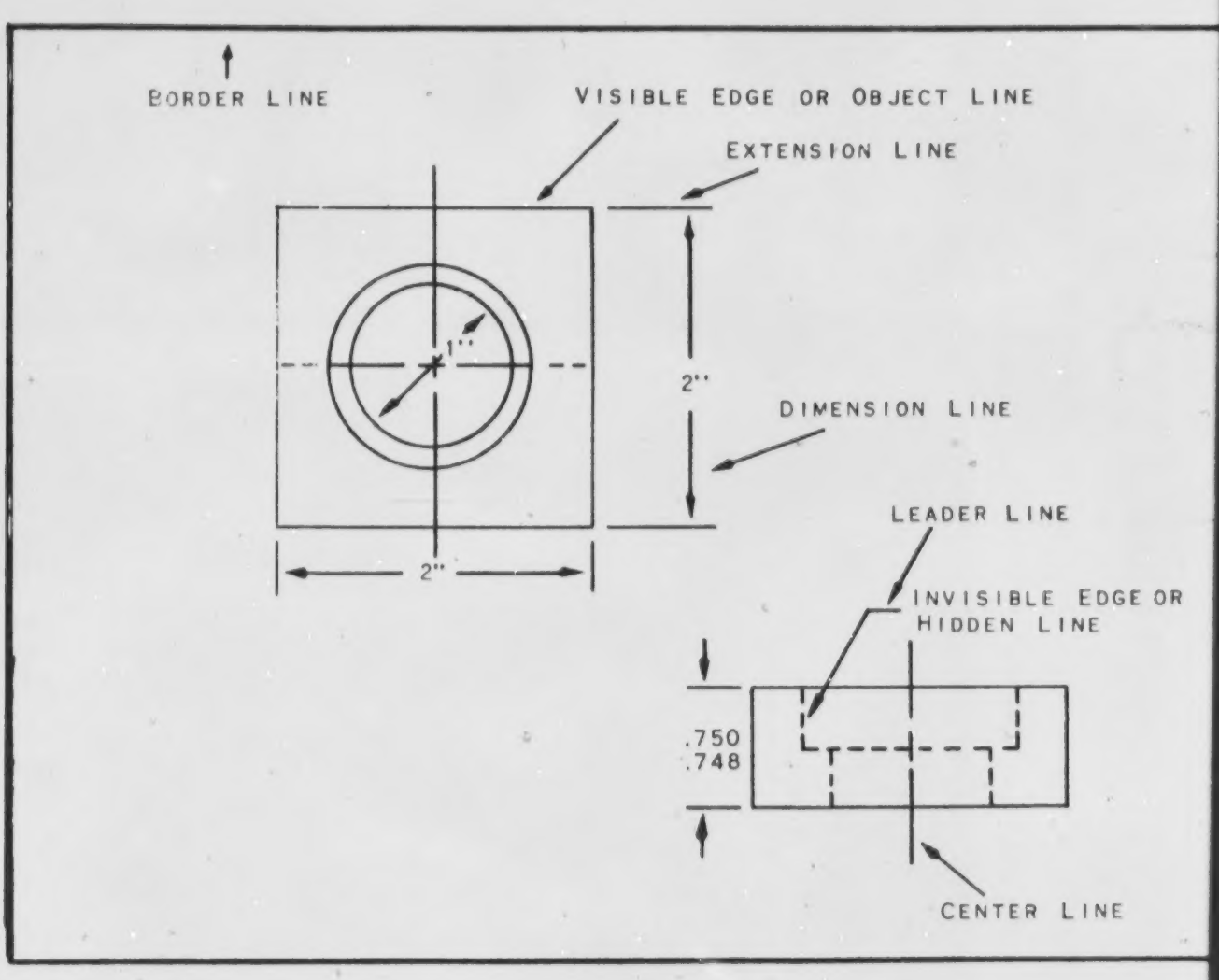
7.4

BASIC LINES USED IN BLUEPRINT READING



7.5

USE OF LINES ON A BLUEPRINT



7.6

THERMAL EXPANSION OF METALS

Experiment #1 - Bimetals

Cut two 20-28 gauge x ½" x 5" metal strips--one of steel and the other of brass. Fasten together with four, one pound tinners rivets.

Hold the bimetal with pliers and heat it over the alcohol burner.

In which direction does the strip bend?_____

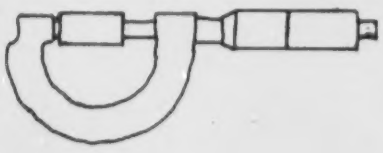
Which metal expanded the greatest amount?_____

Cool the bimetallic strip in cold water. What is the direction of bending?_____

What do you think would happen if the bimetal was cooled to sub-freezing temperatures?_____

Experiment #2 - Thermal expansion

Cut off a 2 inch section of ¼ inch steel rod. Measure the exact length of the rod with a micrometer and record below. Heat the rod along its full length for a few seconds with the alcohol burner. Once again, use the micrometer to measure the length of the rod and record the measurement. From your recordings, notice the differences in measurements.



Some metals lengthen more than others. Repeat the above experiment with a section of aluminum and record the measurements.

	ALUMINUM	LOW CARBON STEEL
Room temperature		
Heated with alcohol burner		

UNIT VII

8.00 MACHINING AND FINISHING METAL 8 Days

OBJECTIVES: At the end of this unit, the student will be able to understand the following major metal machining operations.

UNIT OUTLINE

8.10 Sawing

8.20 Turning

8.30 Milling

8.40 Shaping

8.50 Drilling

8.60 Grinding

8.70 Recent Techniques

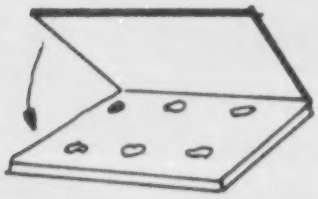
TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapters 8 and 9.

UNIT NO. VIII	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
8.00	MACHINING AND FINISHING METAL THE STUDENT WILL BE ABLE TO:	
8.10	A. Identify the importance of standard stock machining.	A1. The student will discuss the importance of standard stock machining.
8.20	A. Identify the major machining operations.	A1. The student will identify major machining operations. Example: using a router on wood or a milling machine on metal.
8.30	A. Perform selected machining operations.	A1. The student will machine a selected product or subassembly. Example: hammer handle, nailset, etc. A2. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced. Example: how the item in A1. could be mass produced.

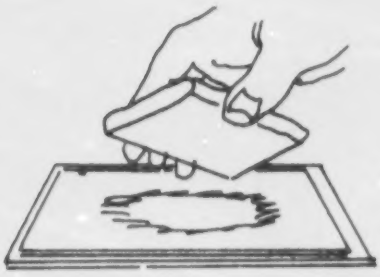
8.2

SEPARATING MATERIALS

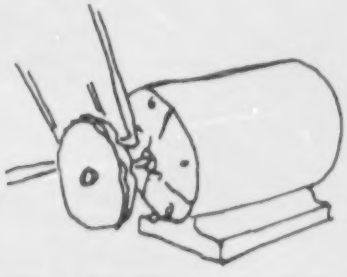
A. Polishing and buffing
20-26 gauge x 1" x 2" brass



1. Glue brass to 4" square of 1/8" masonite with fast setting epoxy

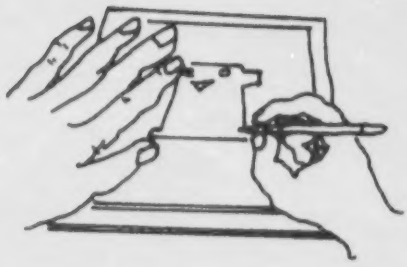


2. Wet sand surface to be polished with 600 grit sandpaper

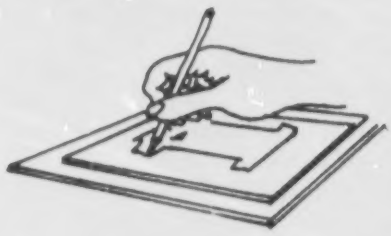


3. Buff on cotton buffing wheel with abrasive compound to desired luster

B. Etching
.020" - .060" x 1" x 2"
bright or anodized aluminum



1. Trace design



2. Cut out with sharp knife

UNIT IX

9.00 FASTENING AND FINISHING METAL 8 Days

OBJECTIVES: At the end of this unit, the student will be able to:

1. Select appropriate methods of bonding metal.
2. Select proper finishes.
3. Understand the process of heat treatment.

UNIT OUTLINE

9.10 Welding
- 9.11 Arc welding
- 9.12 Oxy-acetylene welding
- 9.13 Resistance welding

9.20 Brazing

9.30 Soldering

9.40 Heat Treating
- 9.41 Annealing
- 9.42 Hardening
- 9.43 Casehardening
- 9.44 Tempering

9.50 Adhesive Bonding

9.60 Sheet Metal Assembly

9.70 Mechanical Fasteners
- 9.71 Threaded
- 9.72 Non-threaded

9.80 Polishing and Buffing

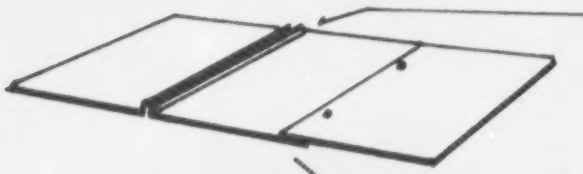
TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 9.

UNIT NO. IX	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
9.00	FASTENING AND FINISHING METAL THE STUDENT WILL BE ABLE TO:	
9.10	A. Select appropriate methods of bonding various metals.	A1. The student will assemble the previously produced subassemblies into a completed product and finish appropriately. Example: hammer, head and handle, etc. A2. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced.
9.20	A. Name and explain major methods of metal finishing.	A1. The student will discuss methods of metal finishes.
9.30	A. Select appropriate methods of coatings for metal finishing.	A1. See A1. above. Example: paint, dip, plate, ect.
9.40	A. Name and explain major methods of fastening metals.	A1. The student will discuss methods of metal finishes.

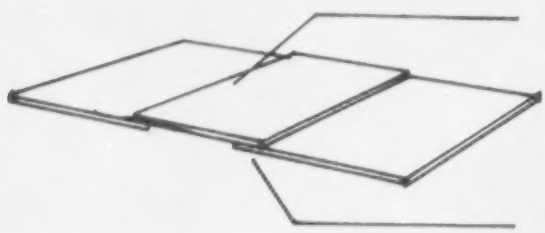
9.3

FASTENING SYSTEMS FOR METALS

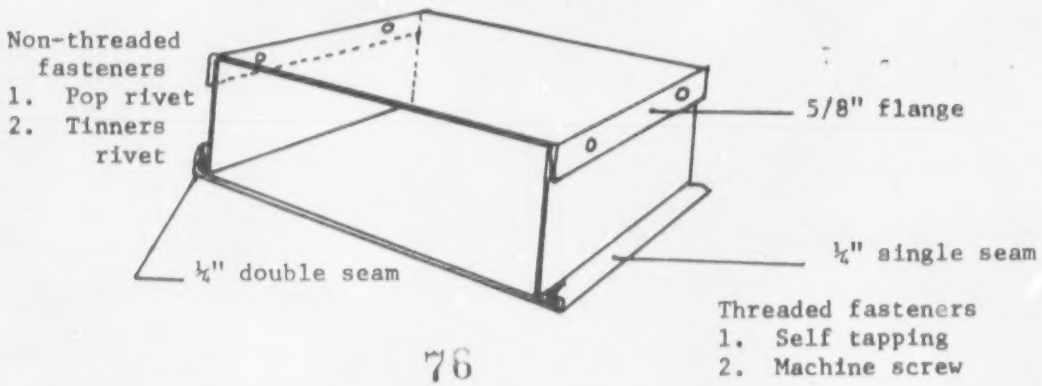
COHESION - mild steel
one piece - 16 gauge x 2" x 5"



ADHESION - mild steel
one piece - 26 gauge x 2" x 5"



MECHANICAL FASTENERS - mild steel
two pieces - 27 gauge x 2" x 5"
two pieces - 26 gauge x 2" x 1½"

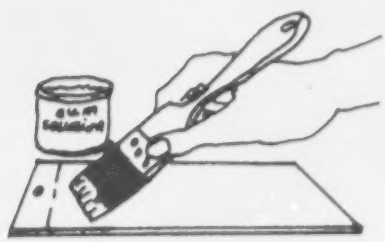


FINISHING SYSTEMS FOR METALS

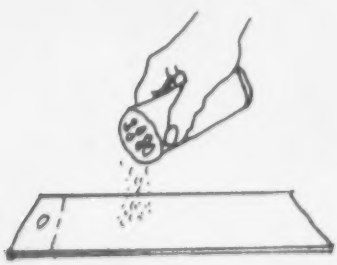
COMBINING MATERIALS

Note: Clean all metals before you add finish materials to them -
Sand lightly with fine sandpaper and wipe clean with alcohol

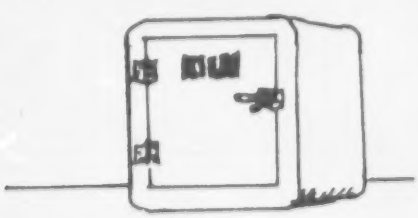
A. Copper enameling
20-26 gauge x 1" x 3" copper



1. Coat with adhesive (gum solution)



2. Coat with dry enamel



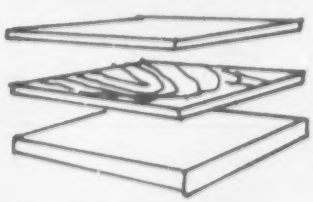
3. Fire 1300° - 10 minutes

B. Lamination
.020" - .060" x 1" x 3"
aluminum

vinyl contact paper 1" x 2"

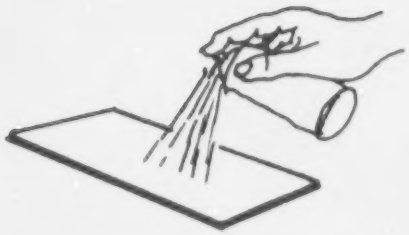
1. Apply vinyl to aluminum

2. Apply pressure to remove air pockets

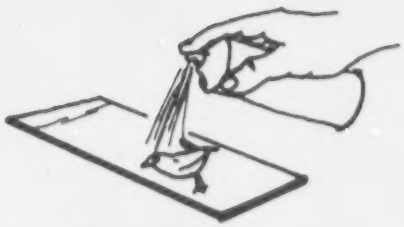


3. Remove part

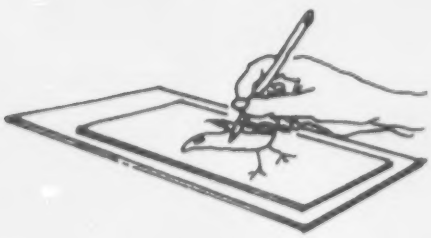
C. Painting



1. Spray with primer

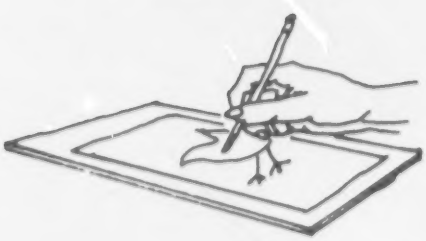


4. Spray stencil figure with contrasting paint



2. Trace design

5. Remove stencil from part



3. Cut stencil from contact vinyl with sharp knife

UNIT X

10.00 LUMBERING AND FOREST PRODUCTS 3 Days

OBJECTIVES: At the end of this unit the student will be able to understand the characteristics and classification of lumbering and forest products.

UNIT OUTLINE

10.10 Characteristics

10.20 Classifications

- 10.21 Hardwoods
- 10.22 Softwoods

10.30 Lumbering

- 10.31 Sawing
- 10.32 Seasoning
- 10.33 Surfacing
- 10.34 Grading

10.40 Plywood

10.50 Hardboard

10.60 Particle Board

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 10.

UNIT NO. X	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
10.00	LUMBERING AND FOREST PRODUCTS THE STUDENT WILL BE ABLE TO:	
10.10	A. Name and explain various lumber and forest products.	A1. The student will name the two classifications of woods and identify those available in the laboratory. Example: open grain vs. close grain, hardwoods vs. softwoods. A2. The student will identify the procedures necessary for processing trees into lumber. Example: use a film or other visual aids, i.e. chart, hand-outs, etc. A3. The student will identify a selected number of primary products of the lumbering industry. Example: chart--see appendix for products from a tree.
10.20	A. Select lumber and forest products suitable for various needs.	A1. The student will select lumber products and calculate cost. Example: go to local furniture store--pick out a coffee table--measure--calculate cost/board feet and compare with retail value.

10.2

UNIT XI

11.00 CUTTING AND SHAPING WOOD 15 Days

OBJECTIVES: At the end of this unit the student will become familiar with the wood cutting and shaping operations.

UNIT OUTLINE

11.10 Planing

11.20 Sawing

11.30 Drilling and Boring

11.40 Turning

11.50 Routing and Shaping

11.60 Sanding

11.70 Bending and Laminating

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 11.

UNIT NO. XI	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
11.00	CUTTING AND SHAPING WOOD THE STUDENT WILL BE ABLE TO:	
11.10	A. Identify the importance of cutting and shaping standard stock.	A1. The student will discuss the importance of standard stock. Example: T x W x L plus grades will be consistent from company to company.
11.20	A. Identify the major cutting and shaping operations as needed.	A1. The student will cut or shape a selected product or subassembly. Example: gun rack, book rack, foot stool, wall shelf.
11.30	A. Perform selected operations.	A1. See A1. above. A2. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced.

UNIT XII

12.00 ASSEMBLING AND FINISHING WOOD 10 Days

OBJECTIVES: At the end of this unit, the student will be familiar with the assembling and finishing processes.

UNIT OUTLINE

12.10 Wood joints

12.20 Adhesive

12.30 Mechanical Fasteners

- 12.31 Threaded
- 12.32 Non-threaded

12.40 Assembly Procedures

12.50 Sanding and Surface Preparation

12.60 Wood Finishes

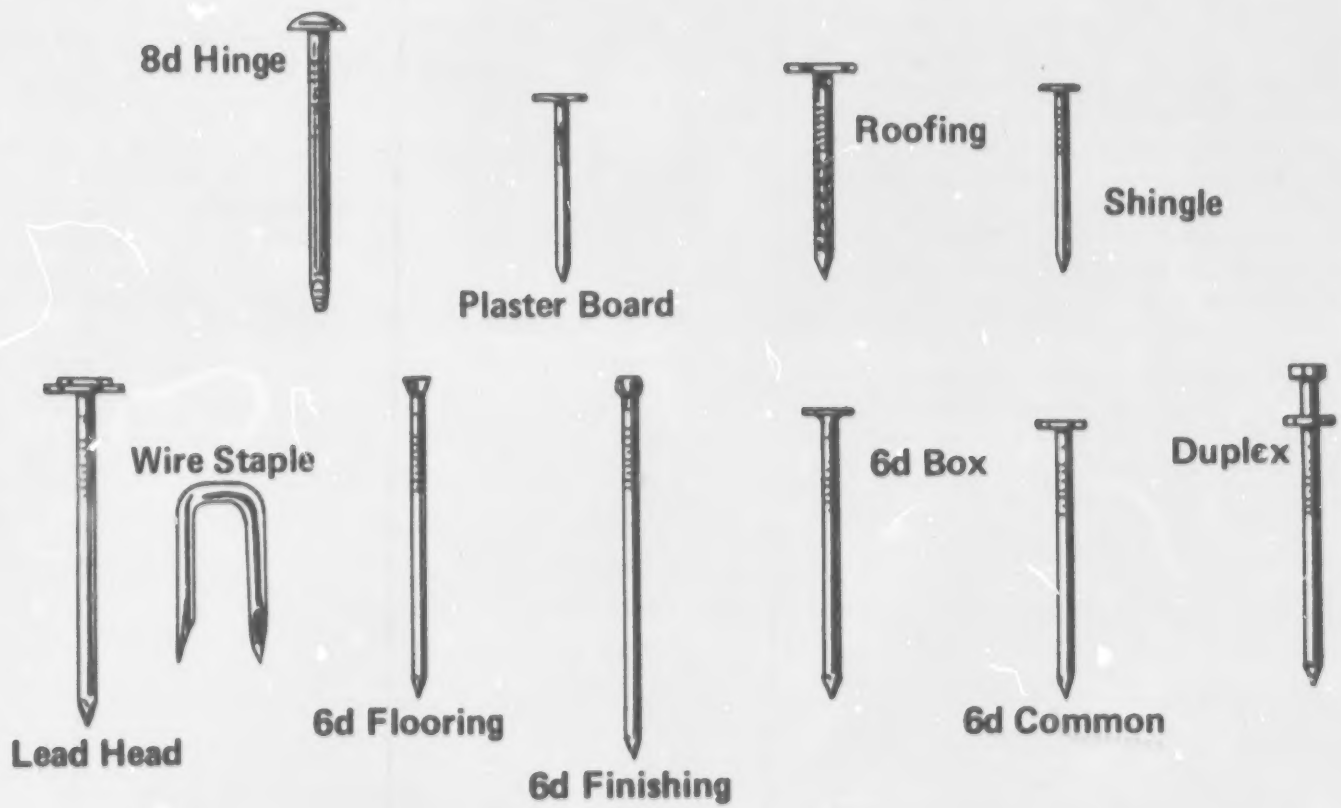
- 12.51 Coloring
- 12.52 Coating

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapter 12.

UNIT NO. XII	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
12.00	ASSEMBLING AND FINISHING WOOD THE STUDENT WILL BE ABLE TO:	
12.10	A. Select appropriate methods of assembling wood products.	A1. The student will assemble the previously produced subassembly into a completed product and finish appropriately. Example: refer to A1. p. 11.2.
12.20	A. Name and explain major methods of fastening wood.	A1. Given a specific problem, the student will determine the most appropriate method of construction. Example: show various techniques of fastening. A2. The student will, as a written assignment, identify the procedures by which the prototype may be mass produced.
12.30	A. Select appropriate methods and materials for wood finishing.	A1. See A1. above.
12.40	A. Name the steps required to correctly finish a product.	A1. The student will list the required steps to correctly finish a product. Example: number of coats, procedure between coats, last or surface coat.

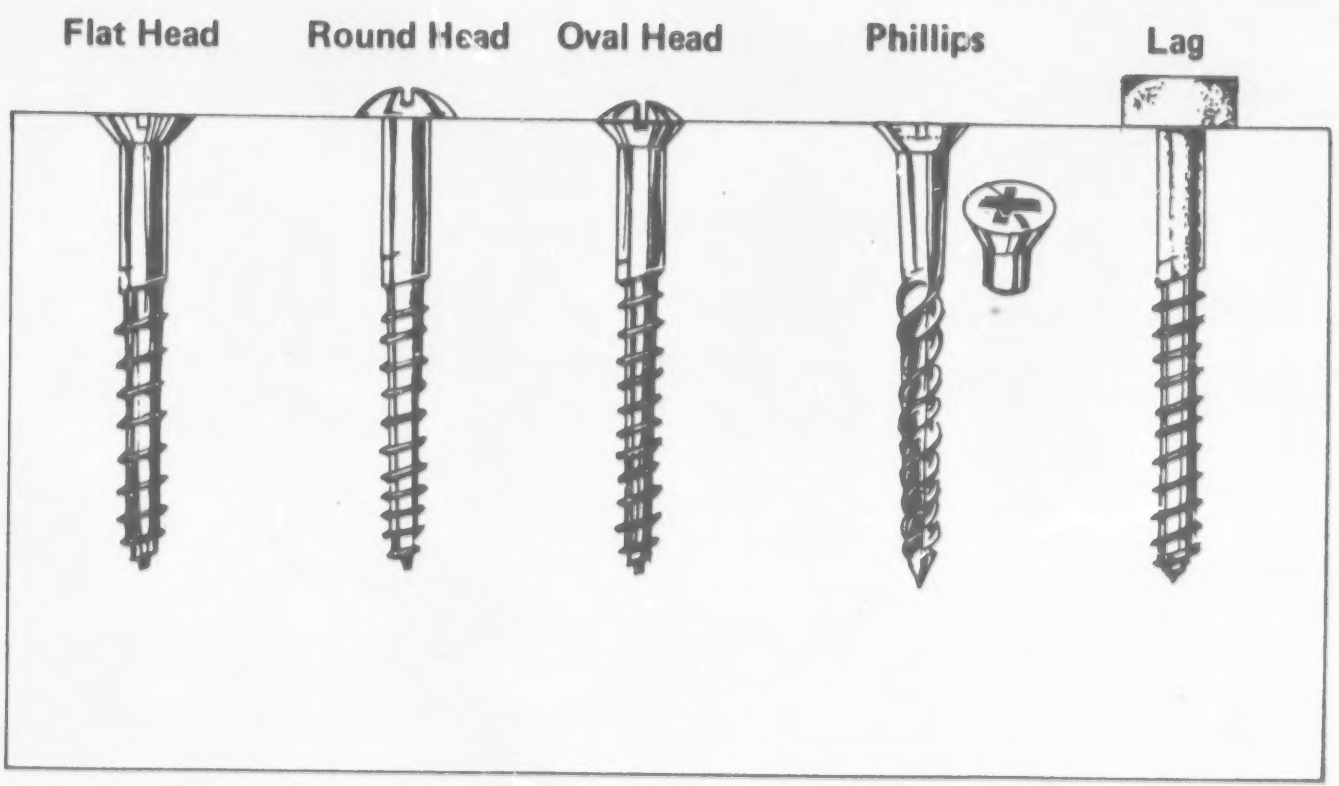
12.2

Types of Nails



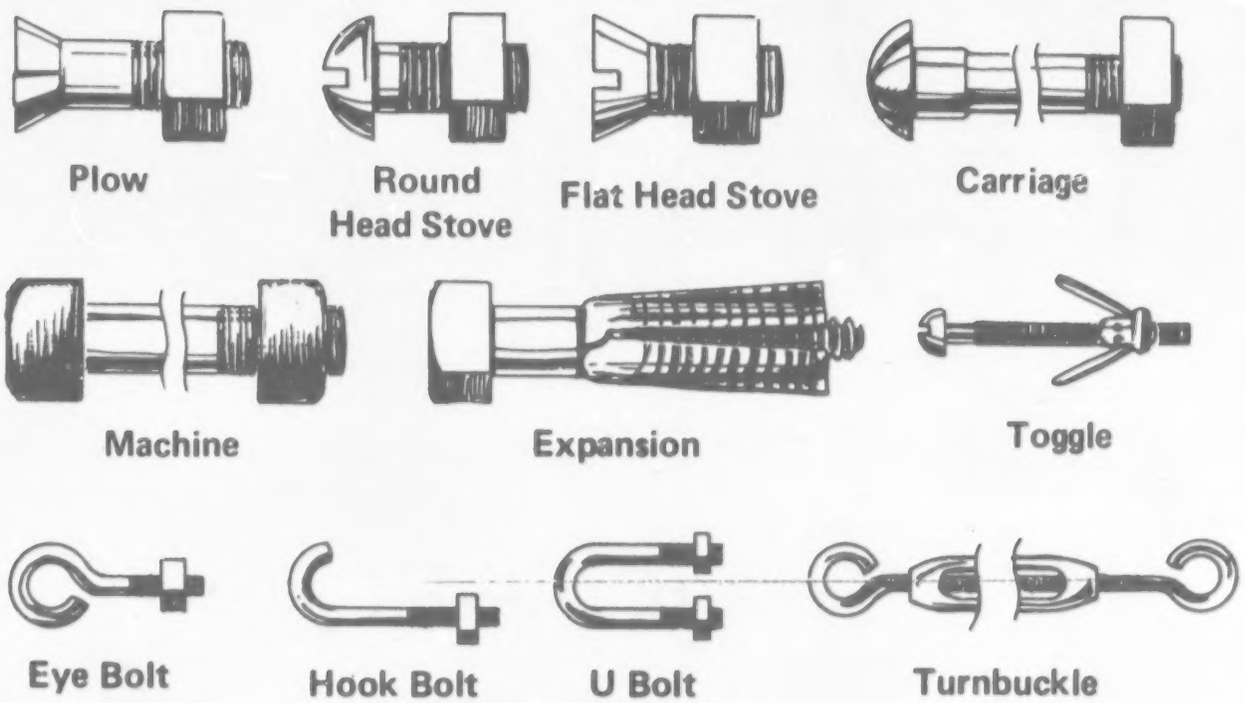
12.3

Types of Screws



12.4

Types of Bolts

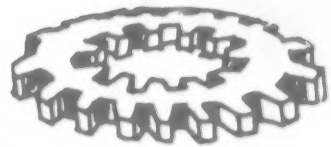


12.5

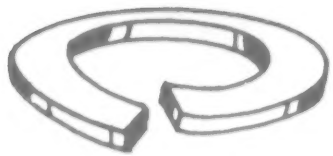
Types of Washers

Plain Washer

Lock Washer
External



Lock Washer
Internal-External



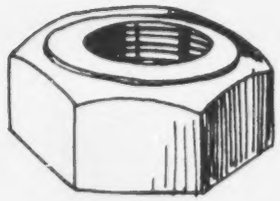
Common
Lock Washer

Lock Washer
Internal

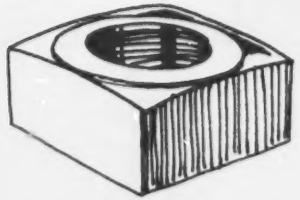
Lock Washer
Countersunk

12.6

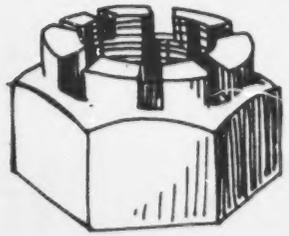
Types of Nuts



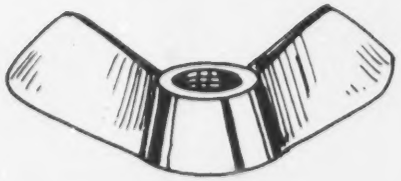
Hexagon



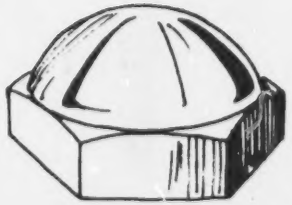
Square



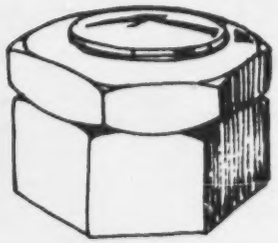
Castle Nut



Wing Nut



Acorn or Cap Nut

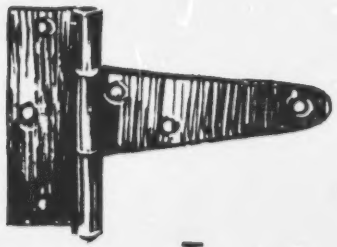


Lock Nut

12.7

Types of Hinges

Strap



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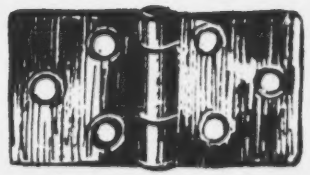
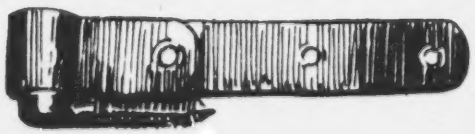


Butt



Screw Hook and Strap

Cabinet

Hasp

12.8

UNIT XIII

13.00 PLASTIC MATERIALS AND PROCESSES 10 Days

OBJECTIVES: At the end of this unit the student will become familiar with the plastic materials and processes. The student will understand the difference between thermoplastic and thermosetting plastics.

UNIT OUTLINE

13.10 Classification

- 13.11 Thermoplastic plastic
- 13.12 Thermosetting plastic

13.20 Molding

- 13.21 Compression
- 13.22 Transfer
- 13.23 Injection
- 13.24 Plastic foam
- 13.25 Blow

13.30 Extrusion

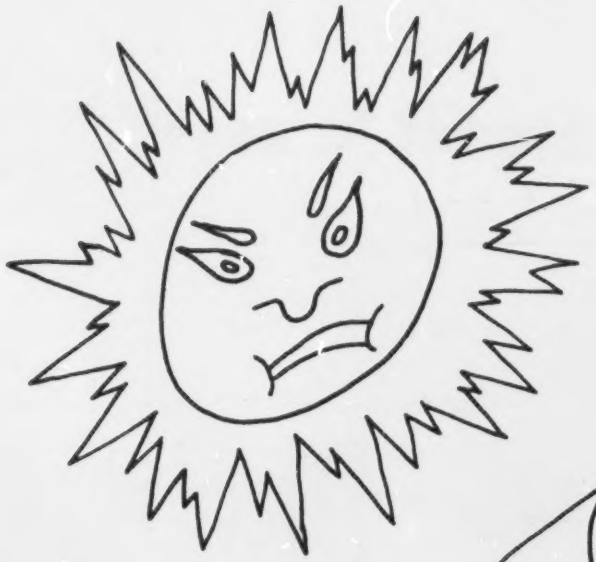
13.40 Thermoforming

13.50 Casting

13.60 Fabricating and finishing

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society, Chicago, Illinois, 1975. Chapters 14 and 15.

UNIT NO. XIII	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
13.00	PLASTIC MATERIALS AND PROCESSES THE STUDENT WILL BE ABLE TO:	
13.10	A. Identify basic materials and process used to manufacture plastic products.	A1. The student will, as a written assignment, identify the processes by which the prototype may be mass produced.
13.20	A. Perform selected processes used by the plastics industry.	A1. The student will, through laboratory experiences, be exposed to machining, fabricating, and finishing plastics. Example: screw driver handle, blow molding, dip casting, vacuum forming, etc. A2. The student will construct a selected product or subassembly. Example: personal choice of various areas under A1.
13.30	A. Name the two families of plastic and list several from each.	A1. The student will name the two main classifications of plastics and identify those available in the laboratory.

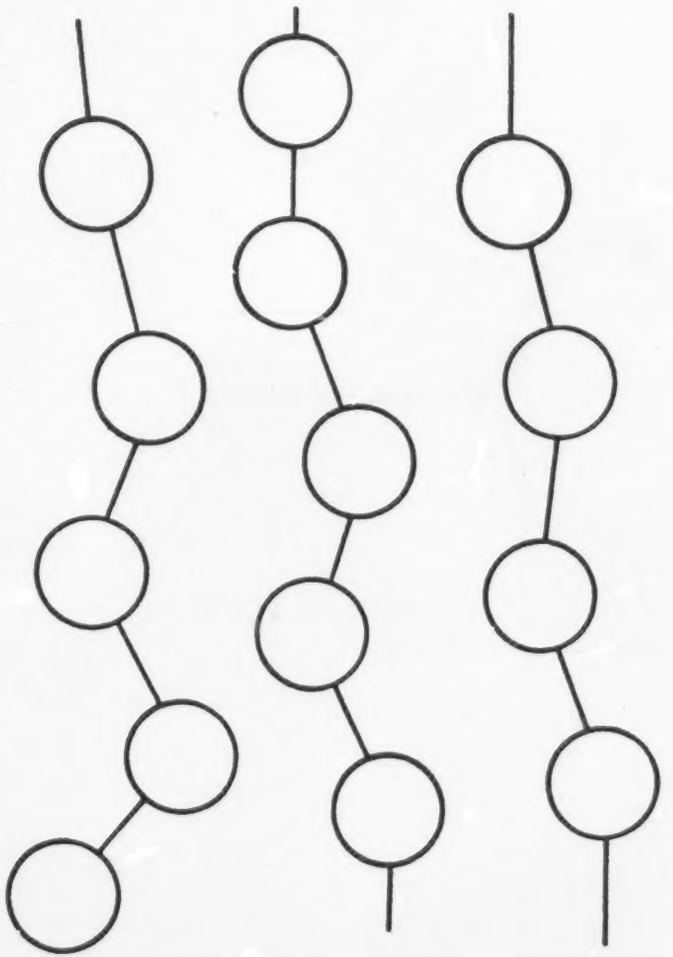


13.3

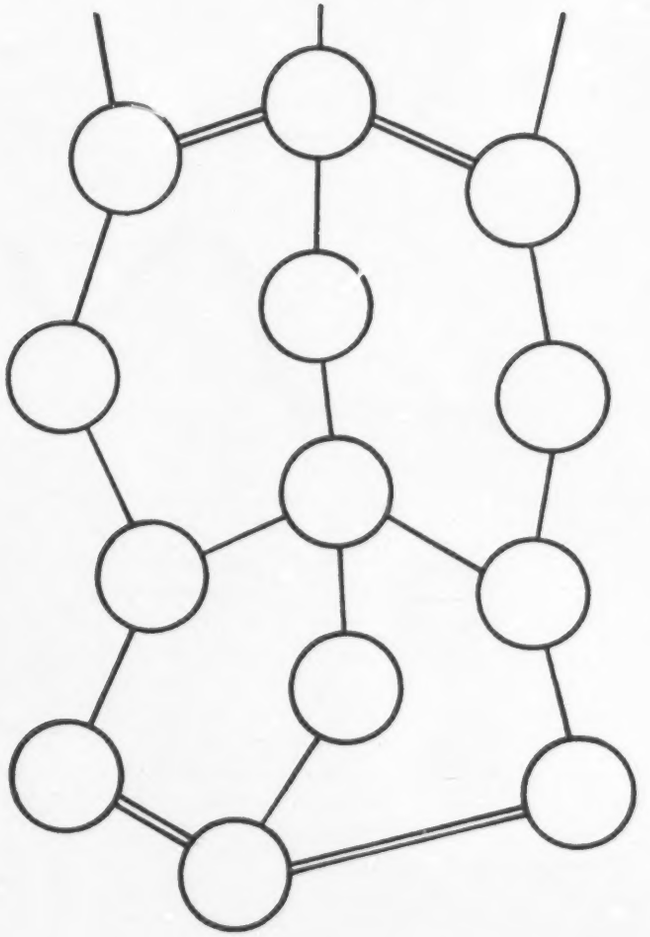
THERMOSETTING

THE PLASTICS MATERIAL BELONGING TO THIS GROUP ARE SET INTO PERMANENT (USUALLY RIGID) SHAPE WHEN HEAT AND PRESSURE ARE APPLIED TO THEM DURING FORMING.

PLASTIC STRUCTURE



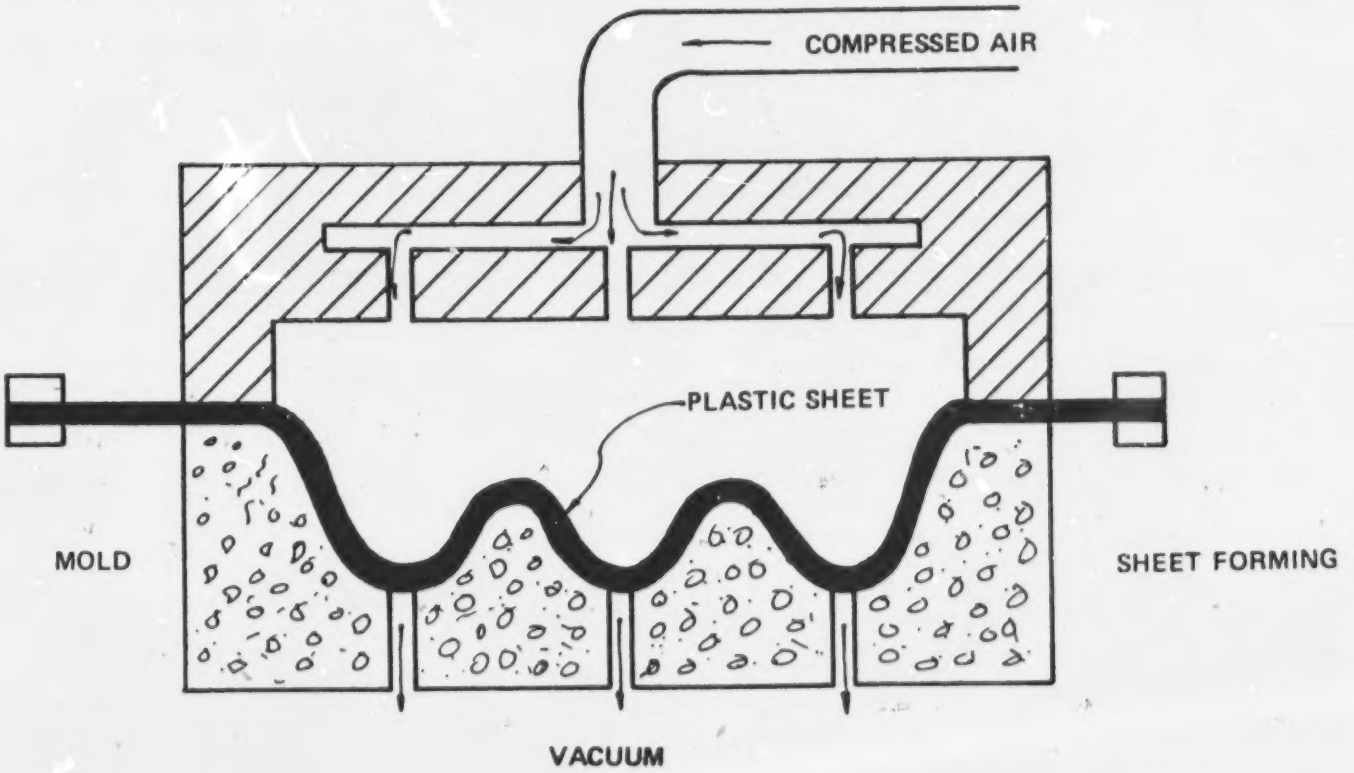
105 THERMOPLASTIC



THERMOSETS 106

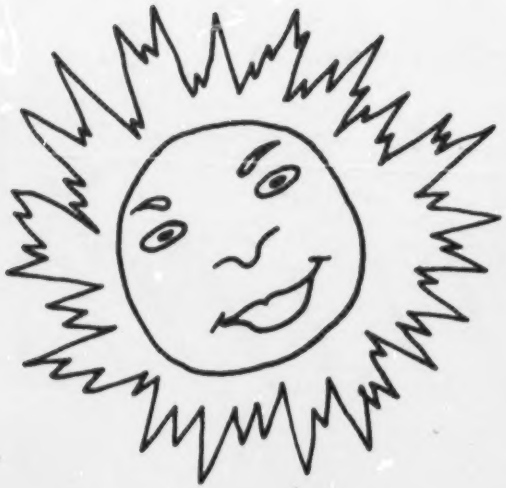
13.4

THERMOFORMING

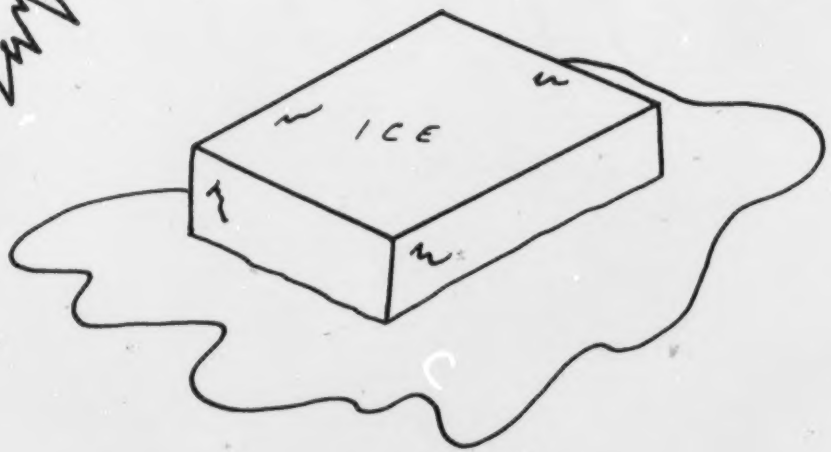


13.5

THERMOPLASTIC

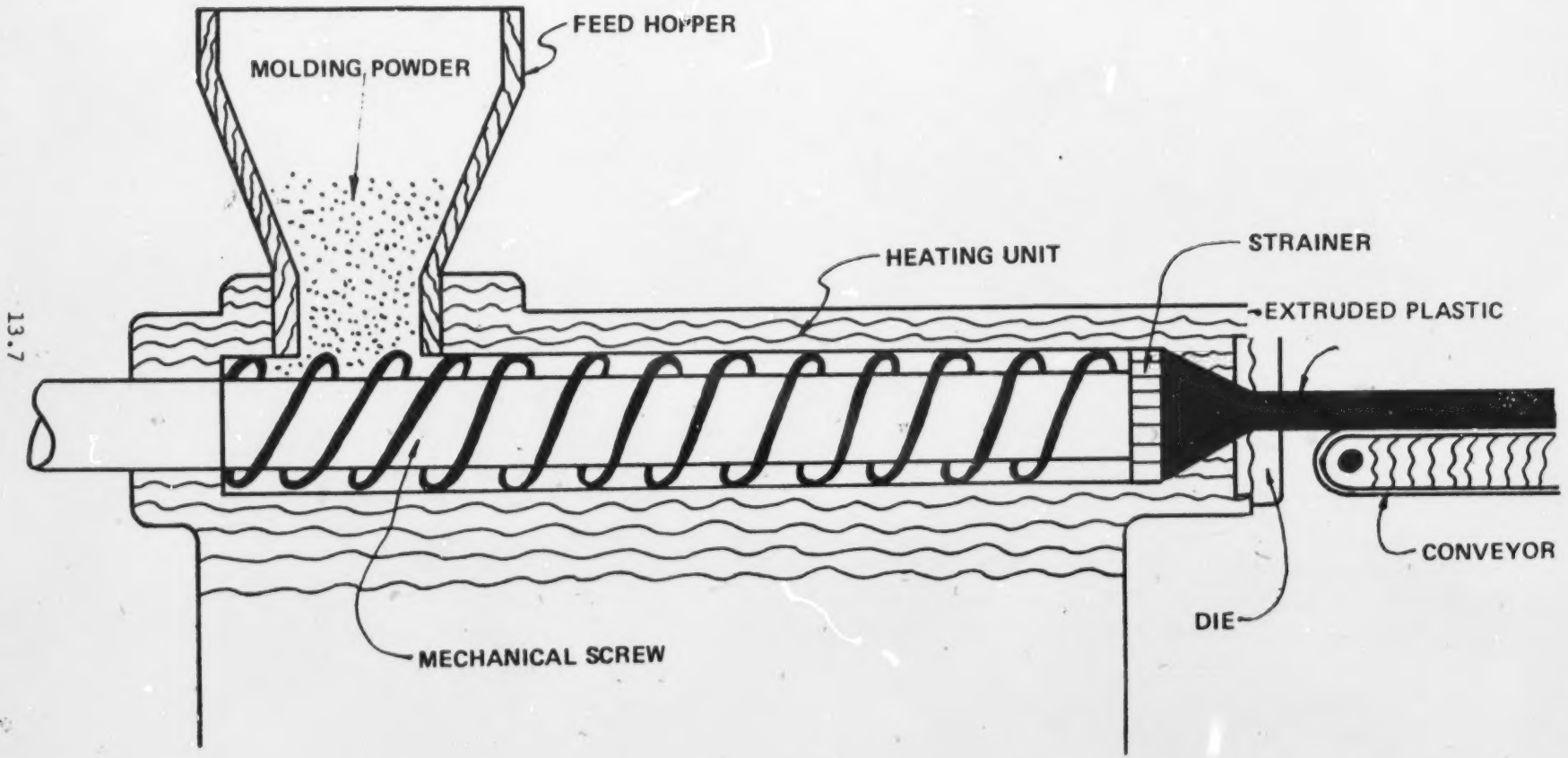


THESE PLASTICS BECOME SOFT WHEN EXPOSED TO SUFFICIENT HEAT AND HARDEN WHEN COOLED, NO MATTER HOW OFTEN THE PROCESS IS REPEATED.



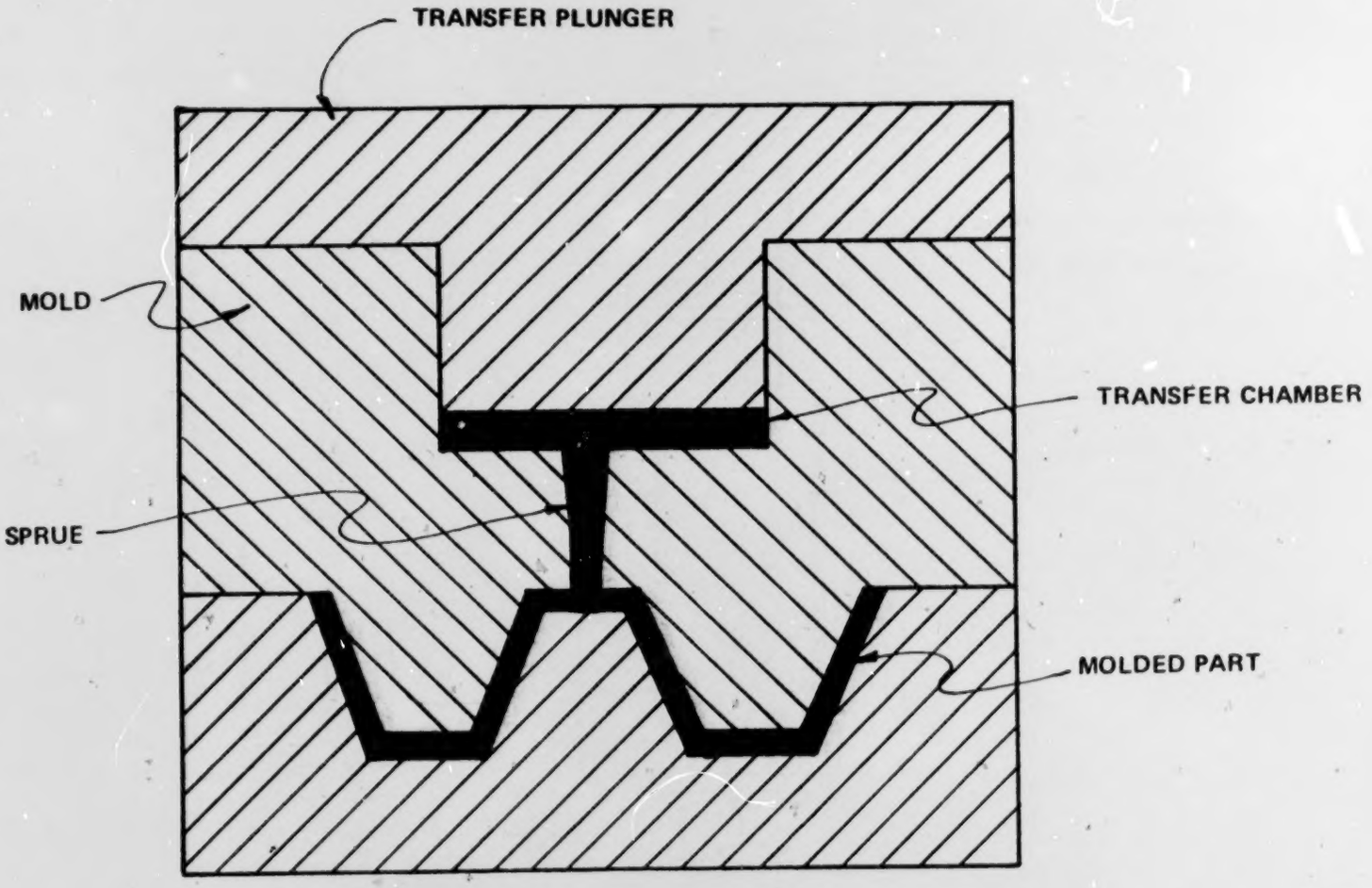
13.6

EXTRUSION MOLDING



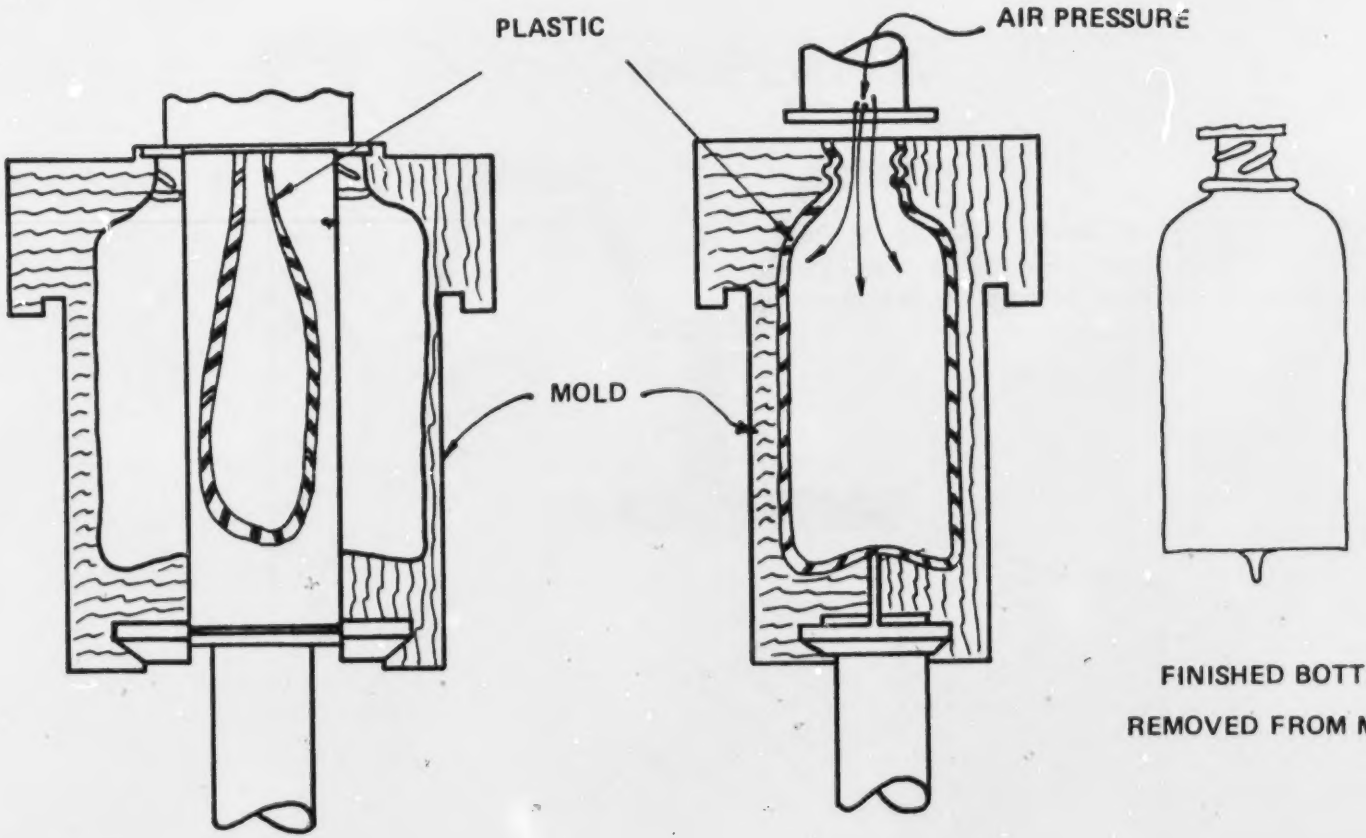
13.7

TRANSFER MOLDING



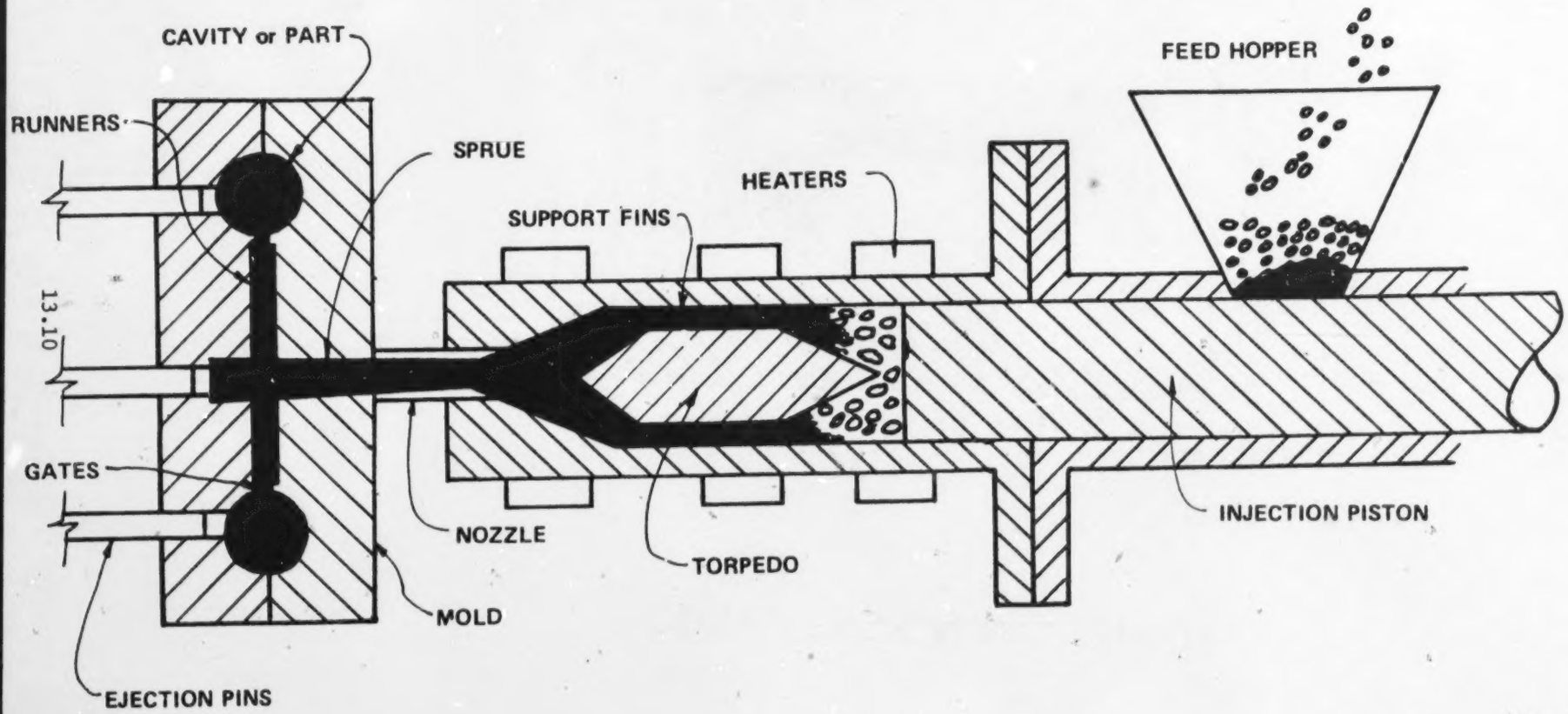
13.8

BLOW MOLDING

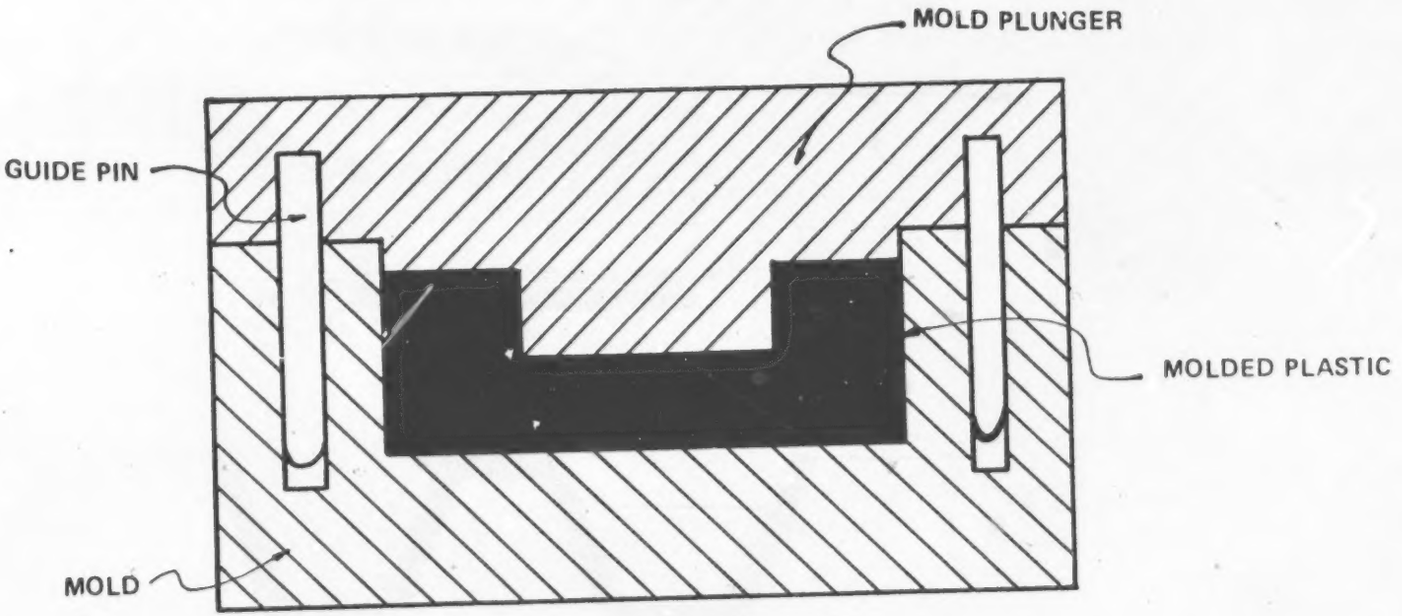


13.9

INJECTION MOLDING

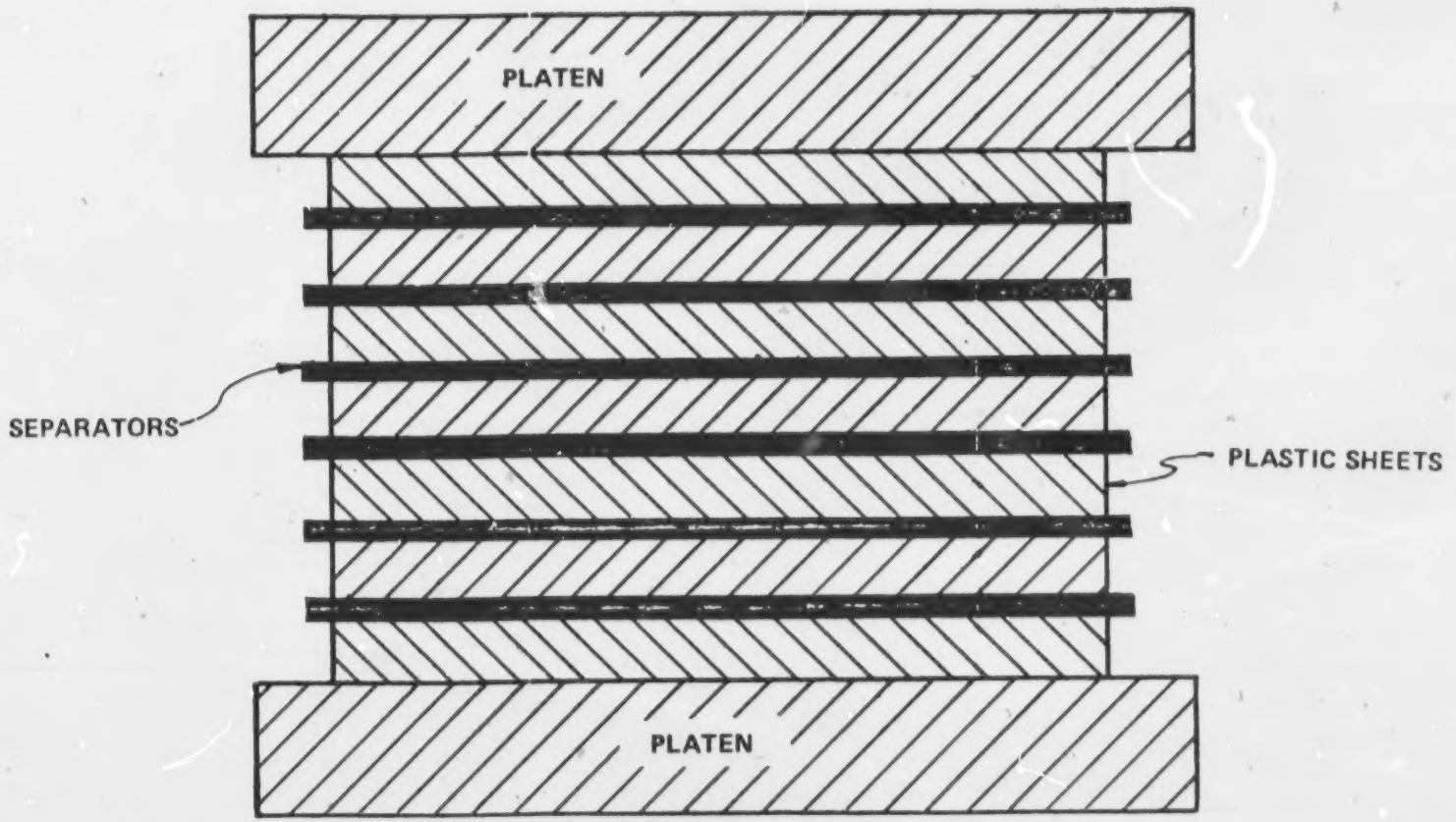


COMPRESSION MOLDING



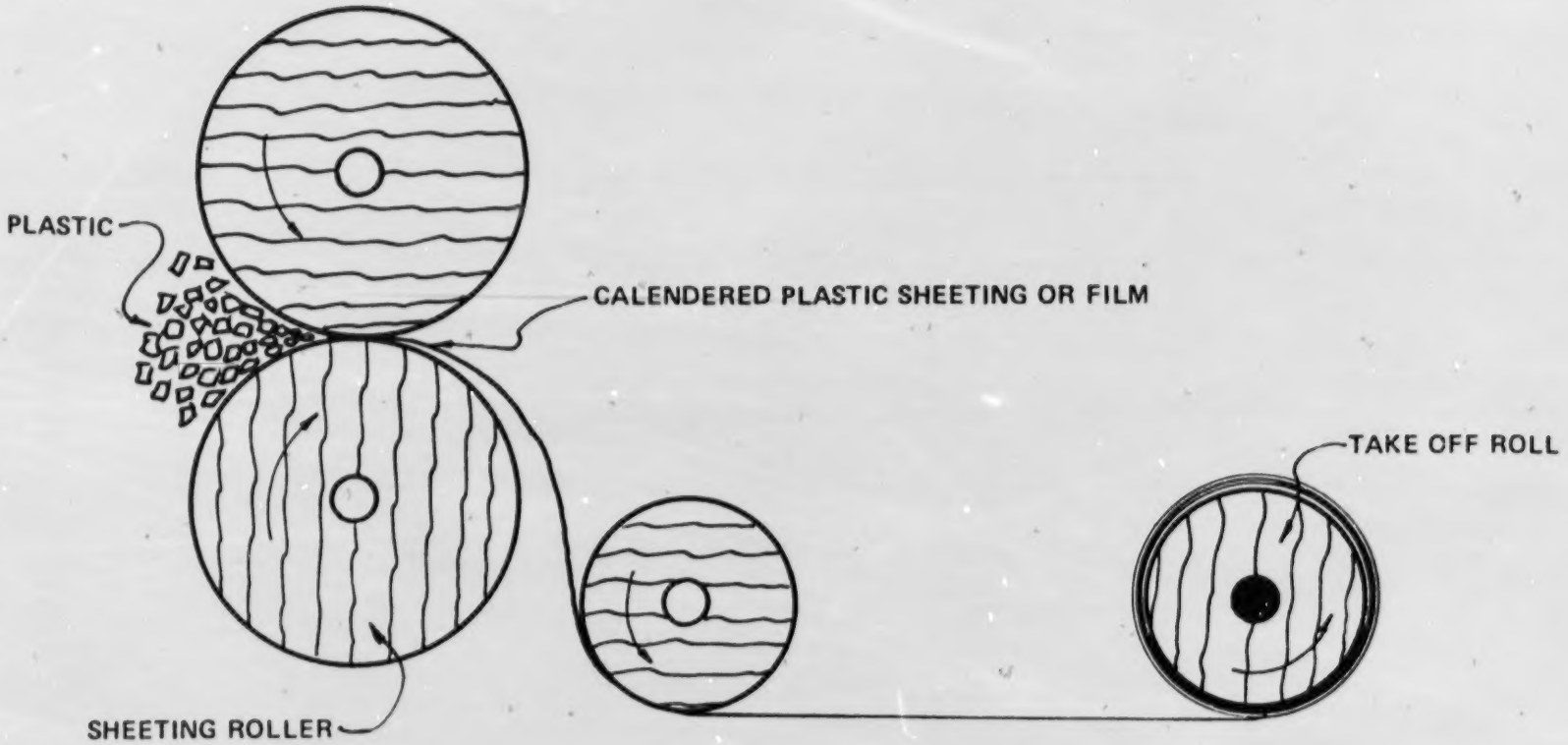
13.11

HIGH–PRESSURE LAMINATING



13.12

CALENDERING



13.13

UNIT XIV

14.00 CAREER OPPORTUNITIES IN MANUFACTURING 2 Days

OBJECTIVES: At the end of this unit, the student will be able to:

A. Explain the different levels of employment and the educational requirements of each

B. Explain the importance of personnel practices.

UNIT OUTLINE

14.10 Levels of Employment

- 14.11 Professional
- 14.12 Skilled
- 14.13 Semi-skilled
- 14.14 Unskilled

14.20 Personnel Practices

- 14.21 Recruiting
- 14.22 Hiring
- 14.23 Training
- 14.24 Working
- 14.25 Advancement
- 14.26 Retirement

14.30 Outlook

TEXT: Wagner, Willis H., MODERN INDUSTRY, American Technical Society Chciago, Illinois, 1975. Chapters 9, 12 and 15.

UNIT NO. XIV	SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
14.00	CAREER OPPORTUNITIES IN MANUFACTURING THE STUDENT WILL BE ABLE TO:	
14.10	A. Explain the levels of employment and the qualifications of each.	A1. The student will explain the levels of employment and the requirements of each. Example: refer to pp. 202--208 IACP World of Manufacturing text.
14.20	A. List and explain the personnel practices used by industry.	A1. The student will identify the basic kinds of personnel practices for employment. Example: refer to pp. 209--231 IACP World of Manufacturing text.
14.30	A. Apply the personnel practices in simulated situations.	A1. See A1. above. Example: have students interview one another for a job application situation.
14.40	A. Project the future of selected occupations.	A1. The student will discuss the future of selected occupations. Example: pp. 202--205 IACP World of Manufacturing text. A2. The student will investigate a chosen career from various sources, such as printed literature, field trips, and personal interviews.

14.2

RESOURCES

APPENDIX A

MANUFACTURING TECHNOLOGY

BIBLIOGRAPHY

TEXT:

Wagner, Willis H., Modern Industry, American Technical Society, Chicago, Illinois, 1975.

REFERENCES:

Ansley, Arthur C., Manufacturing Methods and Processes, Chilton Book Company, Philadelphia, PA, 1972.

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Curry, Estell H., Rolland H. Pardonnet, and Russell W. Symes, General Industrial Arts, D. Van Nostrand Company, Princeton, New Jersey, 1976.

Gerbracht, Carl and Frank E. Robinson, Understanding America's Industries, McKnight and McKnight Publishing Company, Bloomington, Illinois.

Groneman, Chris H., Exploring The Industries, Steck-Vaughn Company, Austin, Texas, 1970.

Haws, Robert W. and Carl J. Schaefer, Manufacturing In The School Shop, American Technical Society, Chicago, Illinois, 1972.

Industrial Technology, Unified School District 259, Wichita, Kansas.

Lindbeck, John R., and Irvin T. Lathrop, General Industry, Chas. A. Bennett Company, 1969.

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Lux, Donald G., Willis E. Ray, and H. Dean Hauenstein, The World of Manufacturing, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1971.

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Miller, Wilbur R., Marion E. Maddox, and Lavon B. Smith, Exploring Careers in Industry, McKnight and McKnight Publishing Company, Bloomington, Illinois, 2nd Ed.

Rusinoff, S. E., Manufacturing Processes--Materials and Production, American Technical Society, 1972.

State of Florida Industrial Arts Manufacturing, Tallahassee, Florida, 1973.

Scobey, Mary-Margaret, Teaching Children About Technology, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1968.

Smith, Lavon Benson and Marion E. Maddox, Elements of American Industry, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1966.

School of Technology, Material Analysis and Processing Systems, Kansas State College of Pittsburg, Topeka, Kansas, 1973.

Wagner, Willis H., Modern Industry, American Technical Society, Chicago, Illinois, 1975.

Zook, Wayne, Manufacturing and Constructing Wood Products, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1972.

APPENDIX B

MANUFACTURING TECHNOLOGY

VISUAL AIDS SOURCES

The teacher will find these visual aids indispensable in this course. While they are available from the sources listed, it would be wise to consult the film libraries at your local schools or nearby universities, as the films may be among their holdings. A study of other film catalogs may reveal other suitable materials.

THE ABC OF HAND TOOLS, Part I, 18 Min.
THE ABC OF HAND TOOLS, Part II, 25 Min.
UP FROM CLAY, 15 Min.
MATTER OF RESPONSIBILITY, 28 Min.
FIREBIRD III, 25 Min.

General Motors Corporation
Public Relations Staff--Film Library
General Motors Building
Detroit, Michigan 48202

AMERICAN INDUSTRY--PAST AND PRESENT, 13 Min.
AUTOMATION--WHAT IS IT? 16 Min.
FOR BEAUTY AND USE, 13½ Min.
QUALITY IN QUANTITY, 13 Min.
SERVICE CENTER FOR INDUSTRY, 15 Min.

National Association of Manufacturers
277 Park Avenue
New York, NY 10017

APPRENTICE TRAINING, 25 Min.
SKILLS FOR PROGRESS, 27 Min.

U.S. Department of Labor
810 North 6th Street
Milwaukee, WI 53203

AUTOMATION COMES OF AGE, 20 Min.

United States Industries, Inc.
6499 West 65th Street
Chicago, IL 60638

CONSERVING A HERITAGE, 15 Min.

Wisconsin Petroleum Council
25 West Main Street
Madison, WI 53703

FUNCTIONS OF INDUSTRY AND YOU, 15 Min.

University of Illinois
Visual Aids Service
Champaign, IL 61820

FUNDAMENTALS OF QUALITY CONTROL, 16 Min.
MATERIAL HANDLING METHODS, 27 Min.
PROFIT THROUGH INDUSTRIAL DESIGN, 16 Min.

Maynard Research Council, Inc.
718 Wallace Avenue
Pittsburgh, PA 15221

INDUSTRIAL RESEARCH--KEY TO JOBS AND PROGRESS, 13 Min.

National Association of Manufacturers
277 Park Avenue
New York, NY 10017

IT' YOUR MOVE, 25 Min.
PRECISION TOOLMAKING AND MACHINING, 25 Min.

Modern Talking Picture Service
8 East 54th Street
New York, NY 10022

MODERN CORPORATIONS, 30 Min.

Sutherland Educational Films, Inc.
201 North Occidental Boulevard
Los Angeles, CA 90026

MOLTEN MAGIC, 20 Min.

Glass Container Manufacturers Institute, Inc.
99 Park Avenue
New York, NY 10018

RIVER WITH A PROBLEM, 28 Min

National Film Board of Canada
310 South Michigan Avenue
Chicago, IL 60604

SMALL BUSINESS, U.S.A., 33 Min.

ROA Films
1696 North Astor Street
Milwaukee, WI 53202

THE LAND OF PROMISE (LABOR AND PRODUCTION), 28 Min.

Jewish National Fund
42 West 69th Street
New York, NY 10021

THE STORY OF THE CUTTING EDGE, 60 Min.
THE STORY OF PRODUCTIVITY, 32 Min.

Do All Company
254 North Laurel Avenue
Des Plaines, IL 60016

THIS IS ADVERTISING, 27 Min.

Association of National Advertisers
155 East 44th Street
New York, NY 10017

FILM STRIPS AND SLIDES (FREE LOAN)

COMPETITION AND RESEARCH IN THE STEEL INDUSTRY
SCIENCE, TECHNOLOGY AND SOCIETY
MONEY AT WORK IN THE STEEL INDUSTRY
THE CANDLE OF AMERICAN INDUSTRY

American Iron and Steel Institute
150 East Forty-Second Street
New York, NY 10017

PAMPHLETS

AMERICAN BATTLE FOR ABUNDANCE
Charles Kettering & Allen Arth
ABC'S OF HAND TOOLS

General Motors
Detroit, Michigan

TOOLS--CREATOR OF CIVILIZATION

Leighton Wilkie
Des Plaines, Illinois

MANUFACTURING IN THE SCHOOL SHOP
Haws & Schaeffer

American Technical Society
Chicago, Illinois

INVENTROS BEHIND THE INVENTORS
Roger Burlingame
THE EVOLUTION OF MASS PRODUCTION

Education Affairs Dept.
Ford Motor Company
Detroit, Michigan

SAFETY IN INDUSTRIAL ARTS LABORATORIES

State Department of Education
Tallahassee, FL 32304

STANLEY TOOL GUIDE

Division of the Stanley Works: Education Department
New Britain, Conn.

MANUFACTURING TECHNOLOGY

VISUAL AIDS

Educators Guide to Free Filmstrips
Educators Progress Service, Inc.
Randolph, Wisconsin 53956

North Dakota State Film Library
Film Catalog
Division of Independent Study
State University Station
Fargo, North Dakota 58103

Educators Guide to Free Teaching Aids
Educators Progress Service, Inc.
Randolph, Wisconsin 53956

The World of Manufacturing
Industrial Arts Curriculum Project
The Ohio State University
McKnight and McKnight Publishing Company
Bloomington, Illinois

APPENDIX C

MANUFACTURING TECHNOLOGY

EQUIPMENT

Item No.	Quantity	Description
1	5	Woodworking bench, 4 station, with 4 vises, 2 unit storage locker base, 54 x 64 x 2 1/4 top
2	20	Wood stools, 24" high; or folding chair
3	1	Wood surfacer (planer) 18", 5 HP motor and switch
4	1	Jointer, 6", 1/2 HP motor and switch
5	1	Circular Saw, 10", tilting arbor, 2 HP motor
6	1	Wood lathe, 12", 1/2 HP motor
7	1	Band saw, wood cutting, 14", 1/2 HP motor and switch
8	1	Scroll saw, 24", 1/3 HP motor and switch, steel stand
9	1	Edge tool bench grinder, 7", 1/2 HP motor, pedestal type
10	1	Drill press, 15", floor model, 1/2 HP motor and switch, high speed 680--4600 rpm, 1/2" chuck
11	1	Sander, combination disc and belt, 1 HP motor, on stand
12	1	Miter box with back saw
13	1	Paint cabinet with work surface, steel, 24" deep x 36" wide x 7' 3" high
14	1	Machine bench, 40 x 60, 2 1/4" maple top
15	2	Sheet metal vises
16	3	Machinist vises

Item No.	Quantity	Description
17	1	Sheet metal bench, 40 x 96, with 2 stake plates
18	1	Anvil stand with 100 lb anvil
19	2	Machinery table, 36" x 76 ", 2 1/4" top maple
20	1	Slip roll, 24", 20 ga. cap.
21	1	Shear, 24", 16 ga. cap.
22	1	Box and pan brake, 24", on stand
23	1	Bar folder, 30"
24	1	General shop tool storage cabinet, with hand tools
25	2	Wall bench, 24" x 76", metal legs
26	1	Metal goggle cabinet with goggles
27	1	Lathe—Miller, 110 V. motor
28	1	Heat treating furnace
29	1	Soldering furnace
30	1	Welding booth, with comb. welding bench, welding curtain, arc welder, acetylene welding outfit
31	1	Molding bin or bench
32	1	Universal bender, and stand
33	1	Buffer, polisher
34	1	Chalkboard
35	1	Tackboard
36	1	Wash up sink, 2 station
37	1	Power hacksaw
38	1	Plastic press
39	1	Plastic oven

Item No.	Quantity	Description
40	1	Plastic strip heater
41	1	Plastics injection molder
42	1	Lumber rack, can be built-in
43	2	Tool and hardware cabinet, metal constr., with lock
44		Shelving, various lengths & widths, see diagram
45	1	Paint bench
46	1	Drying rack
47	1	Glue bench
48	1	Exhaust hood, built-in
49	1	Screen, mounted above 6'